2001

Summary of Research 2001, Department of Information Science

Faculty of the Naval Postgraduate School Department of Information Science

Office of the Associate Provost and Dean of Research, Naval Postgraduate School.

Naval Postgraduate School
Monterey, California 93943-5138

NPS-09-02-018

SUMMARY OF RESEARCH 2001

Department of Information Science

Graduate School of Operational and Information Sciences

Dan Boger
Chair

Alexander Bordetsky
Associate Chair for Research

Approved for public release; distribution is unlimited
Prepared for: Naval Postgraduate School
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NAVAL POSTGRADUATE SCHOOL
Monterey, California

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13. ABSTRACT (Maximum 200 words.)

This report contains project summaries of the research projects in the Department of Information Science. A list of recent publications is also included, which consists of conference presentations and publications, books, contributions to books, published journal papers, and technical reports. Thesis abstracts of students advised by faculty in the Department are also included.

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THE NAVAL POSTGRADUATE SCHOOL MISSION

Increase the combat effectiveness of the U.S. and allied forces and enhance the security of the U.S.A. through advanced education and research programs focused on the technical, analytical, and managerial tools needed to confront defense related challenges of the future.

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PREFACE

Research at the Naval Postgraduate School is carried out by faculty in the four graduate schools (School of International Graduate Studies, Graduate School of Operations and Information Sciences, Graduate School of Engineering and Applied Sciences, and Graduate School of Business and Public Policy) and three Research Institutes (The Modeling, Virtual Environments, and Simulation (MOVES) Institute, Institute for Information Superiority and Innovation (I2SI), and Institute for Defense System Engineering and Analysis (IDSEA). This volume contains research summaries for the projects undertaken by faculty in the Department of Information Science during 2001. The summary also contains thesis abstracts for those students advised by Information Science faculty during 2001.

Questions about particular projects may be directed to the faculty Principal Investigator listed, the Department Chair, or the Department Associate Chair for Research. Questions may also be directed to the Office of the Associate Provost and Dean of Research. General questions about the Naval Postgraduate School Research Program should be directed to the Office of the Associate Provost and Dean of Research at (831) 656-2099 (voice) or research@nps.navy.mil (e-mail). Additional information is also available at the RESEARCH AT NPS website, http://web.nps.navy.mil/~code09/

Additional published information on the Naval Postgraduate School Research Program can be found in:

- *Compilation of Theses Abstracts:* A quarterly publication containing the abstracts of all unclassified theses by Naval Postgraduate School students.
- *Naval Postgraduate School Research*: A tri-annual (February, June, October) newsletter highlighting Naval Postgraduate School faculty and student research.
- *Summary of Research*: An annual publication containing research summaries for projects undertaken by the faculty of the Naval Postgraduate School.

This publication and those mentioned above can be found on-line at:
http://web.nps.navy.mil/~code09/publications.html.

INTRODUCTION

The research program at the Naval Postgraduate School exists to support the graduate education of our students. It does so by providing military relevant thesis topics that address issues from the current needs of the Fleet and Joint Forces to the science and technology that is required to sustain the long-term superiority of the Navy/DoD. It keeps our faculty current on Navy/DoD issues, and maintains the content of the upper division courses at the cutting edge of their disciplines. At the same time, the students and faculty together provide a very unique capability within the DoD for addressing warfighting problems. Our officers must be able to think innovatively and have the knowledge and skills that will let them apply technologies that are being rapidly developed in both the commercial and military sectors. Their unique knowledge of the operational Navy, when combined with a challenging thesis project that requires them to apply their focused graduate education, is one of the most effective methods for both solving Fleet problems and instilling the life-long capability for applying basic principles to the creative solution of complex problems.

The research program at the Naval Postgraduate School consists of both reimbursable (sponsored) and institutionally funded research. The research varies from very fundamental to very applied, from unclassified to all levels of classification.

- Reimbursable (Sponsored) Program: This program includes those projects externally funded on the basis of proposals submitted to outside sponsors by the School's faculty. These funds allow the faculty to interact closely with RDT&E program managers and high-level policymakers throughout the Navy, DoD, and other government agencies as well as with the private sector in defense-related technologies. The sponsored program utilizes Cooperative Research and Development Agreements (CRADAs) with private industry, participates in consortia with government laboratories and universities, provides off-campus courses either on-site at the recipient command, by VTC, or web-based, and provides short courses for technology updates.

- Naval Postgraduate School Institutionally Funded Research (NIFR) Program: The institutionally funded research program has several purposes: (1) to provide the initial support required for new faculty to establish a Navy/DoD relevant research area, (2) to provide support for major new initiatives that address near-term Fleet and OPNAV needs, (3) to enhance productive research that is reimbursably sponsored, and (4) to cost-share the support of a strong post-doctoral program.

In 2001, the level of research effort overall at the Naval Postgraduate School was 148 faculty work years and exceeded $48 million. The reimbursable program has grown steadily to provide the faculty and staff support that is required to sustain a strong and viable graduate school in times of reduced budgets. In FY2001, over 93% of the research program was externally supported. A profile of the sponsorship of the Naval Postgraduate School Research Program in FY2001 is provided in Figure 1.

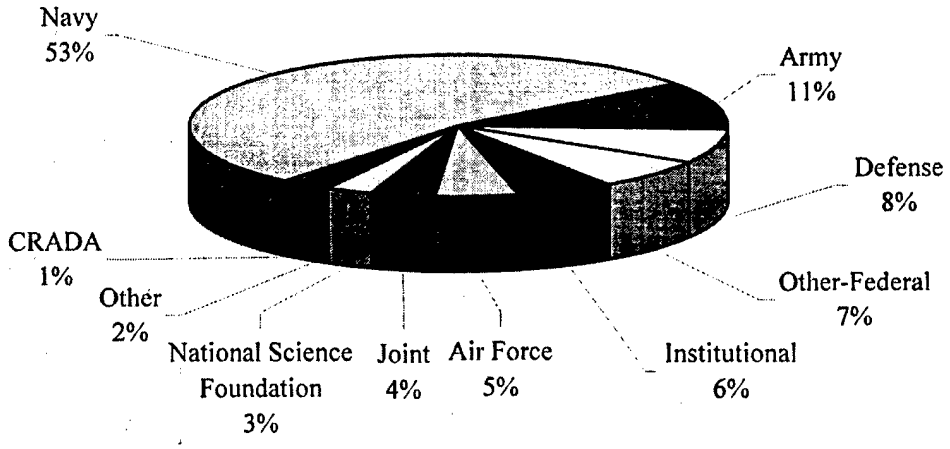


Figure 1. Profile of NPS Research and Sponsored Programs ($52M)

The Office of Naval Research is the largest Navy external sponsor. The Naval Postgraduate School also supports the Systems Commands, Warfare Centers, Navy Labs and other Navy agencies. A profile of external Navy sponsorship for FY2001 is provided in Figure 2.

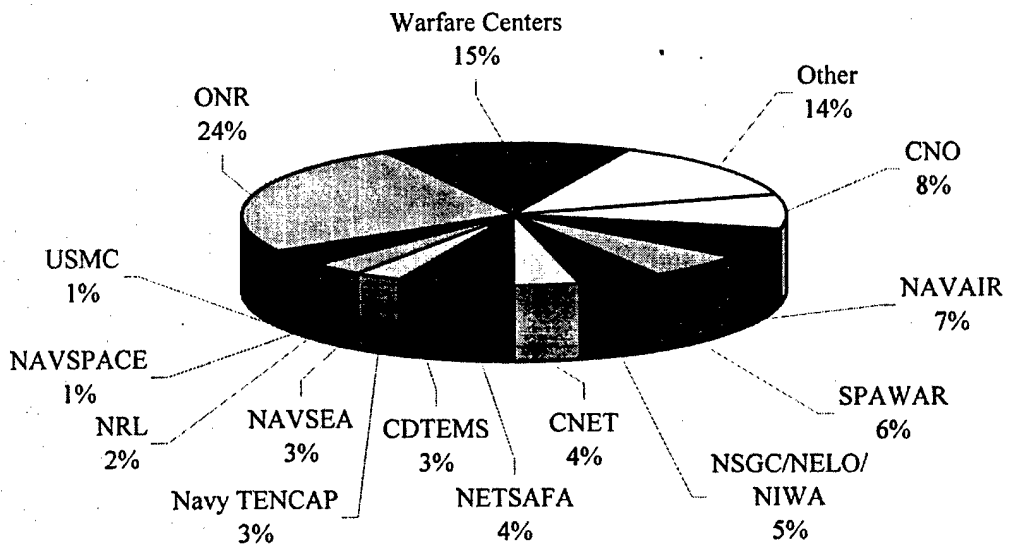


Figure 2. Navy External Sponsors of NPS Research and Sponsored Programs ($29M)

These are both challenging and exciting times at the Naval Postgraduate School and the research program exists to help ensure that we remain unique in our ability to provide education for the warfighter.

DAVID W. NETZER
Associate Provost and Dean of Research

September 2002

DEPARTMENT OF INFORMATION SCIENCE

DAN BOGER
CHAIR

DEPARTMENT SUMMARY

OVERVIEW:

The Information Science (IS) Department is an interdisciplinary association of faculty interested in problems associated with defense information systems, command, control and communications, and information warfare/operations.

CURRICULA SERVED:

- Information Systems Technology
- Information Systems and Operations
- Joint Command, Control, Communications, Computers and Intelligence Systems
- Information Systems Technology
- Information Warfare
- Electronic Warfare Systems International

DEGREES GRANTED:

- Master of Science in Information Systems and Operations
- Master of Science in Information Technology Management
- Master of Science in Systems Engineering
- Master of Science in Systems Technology

RESEARCH THRUSTS:

- Software Metrics and Maintenance
- IT Architectures
- Computer Networks
- Decision Support Systems
- Knowledge Management
- Information Warfare
- Information Superiority
- Information Operations
- Command and Control
- Modeling and Analysis of Military Systems
- Combat Identification
- Human Systems Interface
- Threat Analysis

RESEARCH FACILITIES:

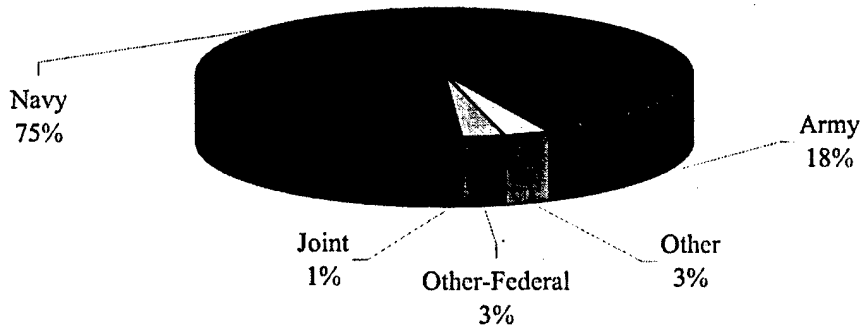
- Systems Technology Laboratories (STL): The Naval Postgraduate School Systems Technology Laboratories provide centrally managed, supported, and funded facilities where students and faculty can conduct research and instruction using tomorrow's C4I systems technologies today. The facilities provide for classified and unclassified capabilities for students and faculty to use for immediate classroom reinforcement, student projects, and theses and for faculty and students to conduct leading edge research in their fields. The labs, through advanced telecommunications and networking, allow local platforms of various types to communicate at very high data rates with each other over the Naval Postgraduate School backbone and with other national laboratories and research facilities worldwide using Internet, SIPRNET, and ATM networks, such as DARPA's Leading Edge Services ATM network, the California Research and Education Net (CALREN), Defense Research and Evaluation Net (DREN), and other wideband wide area networks that define the nation's information infrastructure. Using these capabilities, researchers can

collaborate with leading researchers and can participate in systems technology research efforts of national prominence.

The Naval Postgraduate School Systems Technology Laboratories contain (or have distributed access to) actual command and control systems for exercises and experiments. · The prime example of this is a fully functional CINC version of the Global Command and Control Systems (GCCS) with SECRET interconnectivity to all CINCs and supporting sites. GCCS permits CINCs to complete crisis action plans including assessment, evaluation, and development of options, as will as selection, dissemination and monitoring of execution. The STL routinely conducts experiments with humans in the loop. Operational teams of officer-students can be trained/tested-using wargames as stimuli and using data collection techniques to evaluate performance under varied, but controlled, conditions. Insights into requirements for new doctrine, training and other aspects of the joint environment may be identified that will speed the acceptance of new approaches to decision-making and training.

RESEARCH PROGRAM (Research and Academic)-FY2001:

The Naval Postgraduate School's sponsored program exceeded $49 million in FY2001. Sponsored programs include both research and educational activities funded from an external source. A profile of the sponsored program for the Department of Information Science is provided below.



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ADAPTIVE MANAGEMENT OF WIRELESS C4ISR NETWORKS

Alex Bordetsky, Associate Professor
Department of Information Science
Sponsor: Aprisma Technologies

OBJECTIVE: Explore network management systems capability to identify intrusion detection patterns within the framework of SNMP MIBs analysis in wireless C4I networks

SUMMARY: The NPS team will setup P2P wireless collaborative network testbed with SNMP agents active at each node of the wireless network. The Spectrum systems security management and case-based reasoning agents will be used to identify the SNMP MIB variables most sensitive to the set of denial of service attacks. The results have to be compared with Aprisma findings on managing North Carolina Internet 2 Giga POP and complied in network management knowledge base. Recommendations to Situational Awareness agents providing feedback on network state during the attack will complement the research.

DoD KEY TECHNOLOGY AREAS: Command, Control, and Communications

KEYWORDS: Adaptive Network Management, Wireless Collaborative Networks, C4I Networks, SNMP MIBs, Intrusion Detection, Knowledge-Base, Management Agents, Network-Centric Infrastructures

HUMAN-CENTRIC DESIGN OF COLLABORATOR/AGENT INTERFACES

Alex Bordetsky, Associate Professor
Department of Information Science
Sponsor: Space and Naval Warfare Systems Center – San Diego

OBJECTIVE: Explore the decision support requirements to collaborative technology/agent interfaces for multinational peace keeping and humanitarian operations. Develop the plan and detailed proposal for the following on study of adaptive collaboration interfaces for decision-making in multinational experiments.

SUMMARY: The Naval Postgraduate Team will use the results of current Joint Interactive Planning/Rapid Decisive Operation studies of effective collaboration for multinational peacekeeping and humanitarian operations. The findings of committee, team, and group collaborative architectures decision support requirements, cognitive styles, and cultural barriers of collaborators will be used to address the issues of collaborator/agent interfaces experimental studies. Visual collaborative interfaces, multiple agent platform, and case-based reasoning knowledge management facility at NPS will be used to explore specific requirements to the adaptive human-agent interfaces. The study will result in the proposal the proof-of-concept multinational experiments. In addition to the detailed plan of experiments for exploring adaptive human-agent interfaces the proposal will also address design and implementation of multinational conflict resolution collaborative testbed with Swedish National Defense College.

DoD KEY TECHNOLOGY AREAS: Command, Control, and Communications, Modeling and Simulation

KEYWORDS: Collaborative Interfaces, Multiagent System, Case-Based Reasoning, Knowledge Management, Multinational Experiments, Collaborative Technology, Network-Centric Decision Support

FEEDBACK MECHANISMS FOR AGENT-BASED QOS ADAPTIVE MANAGEMENT OF NETWORKING RESOURCES

Alex Bordetsky, Associate Professor
Department of Information Science
Sponsor: SBC Research Labs

OBJECTIVE: The goal for proposed research is to develop better understanding of how the behavior of two main types of networking nodes, the edge nodes and tandem nodes, could be improved based on the presence of intelligent agents at different observation points within the network. The specific research task is to identify the feedback mechanisms capable of utilizing information gathered by intelligent agents for optimizing network resources usage. The study should focus on the experimental research based on testing and proof-of-concept experiments. The research should provide an experimental background for addressing the problems of networking resources adaptation in Quality of Service Management.

SUMMARY: The project will be conducted in two phases: The project work in phase 1 will be focused on exploring the effects of individual intelligent agents on the usage of edge and tandem node resources. The problems and ways of agents-facilitators communication with SNMP agents and SNMP agents manager will be explored. Effects of agents allocation (concentration) within the network, and usage patterns of agents shared memory will also be investigated.
The second phase will be focused on the effects of intelligent agents cooperation for optimizing the usage of networking resources. How the agents performance and memory responsiveness affect the agents solution on resource reservation along the lines of Call Setup and Connection Control adaptation cycles will be observed. Implementation of how ANN could improve the agents performance in adaptation of networking resources will be explored.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Command, Control and Communications

KEYWORDS: Network Operations Management, Intelligent Agents, Adaptation, Feedback, Agents Memory

INTEROPERABILITY, ARCHITECTURE, AND PLANNING SUPPORT TO SSC CHARLESTON

Rex Buddenberg, Senior Lecturer
Department of Information Science
Sponsor: Space and Naval Warfare Systems Center

OBJECTIVE: To provide support for the fleet NOC and related projects.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications

KEYWORDS: IT Architecture

CNSG COMPUTER NETWORK DEFENSE INITIATIVE

LCDR Raymond Buettner, USN, Military Faculty
Department of Information Science
Sponsor: Naval Security Group Command

OBJECTIVE: Examine and develop new process for supporting computer network defense (CND) efforts of the U.S. Navy. Identify, evaluate and make implementation recommendations for new CND tactics and mechanisms. This effort will primarily focus on pattern less intrusion detection (PID), external threat assessment (ETA) warning mechanisms and the development of a firewall assessment modeling methodology but may include other efforts as identified by the principal investigator.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Information Operations, Information Warfare, Modeling and Simulation, Computer Network Defense

INFORMATION OPERATIONS MODELING AND SIMULATION

LCDR Raymond Buettner, USN, Military Faculty
Department of Information Science
Sponsor: Office of Naval Research

OBJECTIVE: Examine current modeling and simulation efforts to determine tools that may be useful to the IO/IW community. Analyze suitable modeling and simulation tools to determine those which warrant continued study. For selected applications, develop recommendations and modifications to permit evaluation for use by information warriors. Simultaneously identify models that can increase the quality of IO education either through classroom use or thesis research opportunities.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: Information Operations, Information Warfare, Modeling and Simulation, Influence Modeling, Reflexive Modeling

INTERNET OPERATIONS PROJECT

LCDR Raymond Buettner, USN, Military Faculty
Department of Information Science
Sponsor: Joint Information Operations Center

OBJECTIVE: Examine and develop processes for developing and applying specialized web sites to existing operational needs as defined by joint and Navy regional and combat CINCs. Identify information operations tactics and procedures to optimize effectiveness of these web sites for full spectrum IO across the range of peace-crisis-conflict.

DoD KEY TECHNOLOGY AREAS: Other (Information Operations)

KEYWORDS: Information Operations, Information Warfare, Modeling and Simulation

GUN WEAPONS SYSTEM COMMAND AND CONTROL PROJECT

Alexander Callahan, Research Assistant Professor
Department of Information Science
Sponsor: Naval Surface Warfare Center – Crane Division

OBJECTIVE: Provide gun weapon system analysis of performance and command and control to include consulting, modeling and simulation.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications

KEYWORDS: Analysis, Modeling and Simulation

NAVAL SIMULATION SYSTEM (NSS) DEVELOPMENT AND TESTING

Alexander Callahan, Research Assistant Professor
Department of Information Science
Sponsor: Commander in Chief, Pacific Fleet

OBJECTIVE: To provide development of scenarios and operational testing of the Naval Simulation System. Scope includes planning, modeling, simulation and analysis.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: Analysis, Modeling, Simulation

NAVAL SURFACE SUPPORT FOR JOINT LAND WARRIOR STUDY

Alexander Callahan, Research Assistant Professor
Department of Information Science
Sponsor: Naval Surface Warfare Center – Crane Division

OBJECTIVE: This study will provide an analysis of the methodology to evaluate the effective use of Naval surface gunfire support of the joint land warrior in expeditionary maneuver warfare. The scope will include the use of modeling and simulation techniques recently developed for the Naval Simulation System (NSS) and other appropriate analytic systems.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: Naval Simulation System, Joint Land Warrior, Expeditionary Maneuver Warfare

USAREC RECRUITING STRATEGIC VISION PROGRAM (RSVP) WARGAME SIMULATION FOR STRATEGIC PLANNING AND DECISION SUPPORT

Daniel R. Dolk, Professor
Department of Information Science
Sponsor: U.S. Army Recruiting Command

OBJECTIVE: The objective is to create and conduct a reusable, multi-player war game simulation for the Army recruiting leadership (RSVP/ARL). The purpose of this simulation is to explore strategic planning dimensions of the recruiting organization in the Army with the specific goal of being able to provide specific guidelines to the officers attending the annual summer leadership meeting at USAREC. This system will not be a prototype but an operational simulation that will be used and updated on an annual basis. The work on this project will lead to a second phase involving development of a detailed recruiting market simulation (RSVP/RMS) that will allow USAREC to test the virtual effectiveness of various new recruiting-oriented products and market strategies. Leveraging the powerful agency technology of SEAS, this simulation will be able to emulate meaningful market segments and provide valuable insight into relevant market behavior. This will facilitate the preliminary identification of "more promising" vs. "less promising" products prior to the expensive activity of national testing.

DoD KEY TECHNOLOGY AREAS: Manpower, Personnel and Training

KEYWORDS: Agent-Based Simulation, Military Recruiting Policy

USAREC RECRUITING STRATEGIC VISION PROGRAM RECRUITING WARGAME MARKET SIMULATION (RSVP/RMS) WARGAME

Daniel R. Dolk, Professor
Department of Information Science
Sponsor: U.S. Army TRADOC Analysis Command

OBJECTIVE: This is the second phase of the RSVP project for implementing strategic business war-games at USAREC. The objective of this phase is to develop a detailed recruiting market simulation (RSVP/RMS) that will allow USAREC to test the virtual effectiveness of various new recruiting-oriented products and market strategies. Leveraging the powerful agent technology of the SEAS environment, this simulation will be able to emulate meaningful market segments and provide valuable insight into relevant market behavior. This will facilitate the preliminary identification of "more promising" vs. "Less Promising" products prior to the expensive activity of national testing.

SUMMARY: Two major thrusts have occurred in this project: (1) a 2nd version of the strategic war game simulation (SWGS) to be presented in September 2002, and (2) an operational decision support system (ODSS) for the CG of USAREC. The user interface for the ODSS and for presenting results of the SWGS are identical. This allows a seamless transition from viewing data about real world operations, as contained in the USAREC data warehouse, and viewing data from simulations that implement various recruiting policies and decisions specified by the war game players.

DoD KEY TECHNOLOGY AREAS: Manpower, Personnel and Training, Modeling and Simulation, Human Systems Interface

KEYWORDS: Agent-Based Simulations, OLAP, Military Recruiting Policy

DEVELOPMENT OF THE HCDA FOR THE MANNING AFFORDABILITY PROJECT

Sue Hutchins, Research Associate Professor
Department of Information Science
Sponsor: Naval Air Warfare Center - Training Systems Division

OBJECTIVE: The focus of this year's effort will be collecting additional case studies to illustrate potential system design problems and working with the HCDA design team to translate the case studies to a format that will be useful for incorporation into the HCDA. The case studies are to represent the range of design problems found in complex military command and control systems and the ways in which these types of problems can be avoided in future system design.

SUMMARY: The overall purpose of this effort is to support the development of the Human-Centered Design Associate (HCDA), an intelligent software agent designed to provide human factors knowledge and expertise to a system designer. In particular, there are three tasks. The first task is to provide human factors case studies of system design to populate the database of the intelligent search agent component of the HCDA. The second task is to provide guidance in the search for additional high payoff areas within the system design process that can be supported with HCDA components. The third task is to support the testing and evaluation of each component of the HCDA.

DoD KEY TECHNOLOGY AREAS: Human Systems Interface

KEYWORDS: Human Factors, Automation, Decision Theory/Support System, Command and Control, Human-System Interface

COMMANDING AND CONTROLLING 21st CENTURY MILITARY FORCES: THE COMMAND AND CONTROL – EMERGING EFFECTS FRAMEWORK

Erik Jansen, Senior Lecturer
Carl R. Jones, Professor
Michael G. Sovereign, Professor Emeritus
Department of Information Science
Sponsor: Unfunded

OBJECTIVE: Develop an analytical framework to describe, design, operate, and adapt military forces for mission success in a 21st century ecology of conflict and cooperation.

SUMMARY: The Command and Control – Emerging Effects (C2E2) framework is comprised of concepts for (1) organizing the force in terms of a problem-focused logic, (2) embedding the organized logic in a physically realizable force architecture with specifications for manpower and technical systems, (3) understanding the executable force as a resourced force architecture comprised of control – coordination processes and a command process observed as a dialogue involving interpreting, assessing, deciding, leading, and collaborating, and (4) the executing operational force. The force's evolution is an element of the evolution of the ecology of conflict and cooperation with emerging effects among friends, foes, and neutrals. The C2E2 framework can be used to understand such phenomena as force vulnerability, adaptation, self-organizing, self-synchronization, knowledge and information engineering and management, network centric warfare, and effects-based warfare.

DoD KEY TECHNICAL AREAS: Battlespace Environments, Command, Control, and Communication, Modeling and Simulation

KEYWORDS: Command, Control, Command and Control, Joint Technical Architecture, C4ISR Systems, Organizational Sciences, Management, Leadership, Ecological Evolution, Complex Adaptive Systems

DEVELOPMENT OF AN ADVANCED PROOF-OF-CONCEPT WORLD WIDE WEB PROTOTYPE APPLICATION FOR ONLINE RECRUITING

Magdi N. Kamel, Associate Professor
Department of Information Science
Sponsor: U.S. Military Entrance Processing Command

OBJECTIVE: The objective of this research is to develop an advanced proof-of-concept world wide web prototype application to support prospecting, attracting, screening, closing the sale, and processing of new Navy recruits.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Application and Development, World Wide Web, Internet, E-Commerce, Military Recruiting

DEVELOPMENT OF A REPEATABLE EDUCATION AND TRAINING NEEDS ASSESSMENT PROCESS FOR SPAWAR INFORMATION TECHNOLOGY

Magdi N. Kamel, Associate Professor
Department of Information Science
Sponsor: Space and Naval Warfare Systems Command

OBJECTIVE: The objective of this research is to develop a repeatable education and training needs assessment process for the ITC workforce.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Needs Assessment, Requirements Identification, Education, Training

ADAPTIVE ARCHITECTURES FOR COMMAND AND CONTROL (A2C2)

William Kemple, Associate Professor
Department of Information Science
Sponsor: Office of Naval Research

OBJECTIVE: To investigate adaptation in joint C2 architectures and to develop theories of C2, i.e., "Congruence" of task organization. To use modeling to identify near-optimal organizational decisions for C2 tasks. Other goals include testing the theories and models in a series of experiments and supporting implementation of adaptable C2 architectures.

SUMMARY: The Adaptive Architectures for Command and Control (A2C2) research project is a multi-year program of basic and applied research featuring model-based experimentation and including "outreach" to DoD/DoN operational, experimental and concept development activities. The program is a collaborative effort involving industry, university and government researchers. Program goals include: 1) extending 14+ years of naval composite warfare decision-making research into the Joint Command and Control (C2) arena; 2) focusing on adaptive architectures within decision-making organizations; and 3) producing results that range from the purely theoretical to those that can be used by operational forces. The prototype A2C2 experiment design combines an operational scenario, computer-based architecture models and model-based predictions of the performance of those architectures on the operational scenario. The experiment tests these architectures in a series of human-in-the-loop experiments using military officers operating in a Joint setting as the test subjects and also provides feedback to the models.

DoD KEY TECHNOLOGY AREAS: Human Systems Interface

KEYWORDS: Command and Control, Joint Operations, Organizational Experiments

NAVAL POSTGRADUATE SCHOOL EFFORT TO SUPPORT GLOBAL WARGAME 2001

William Kemple, Associate Professor
Sue Hutchins, Research Associate Professor
Department of Information Science
Sponsor: Office of Naval Research

OBJECTIVE: NPS support for global wargame 2001 will consist of two components: The first component involves direct support to advancing A2C2 research; the second involves providing support to the joint force command J9 effort.

SUMMARY: New warfighting concepts are currently under development at U.S. Joint Forces Command (JFCOM), J9, Joint Experimentation Directorate, to support the U.S. military as it transitions to the Fighting Force described in Joint Vision 2020. Joint Vision 2020 stresses the need for achieving full spectrum dominance, where forces support the military capability to perform missions from peacekeeping to conflict deterrence prevention to fighting and winning against fully capable enemies. This is to be accomplished by using the latest advances in computer technology, information superiority, improved jointness, precision operations, dominant maneuver, focused logistics, and full-dimension protection. Implementation of these new concepts will occur via new ways of organizing the Joint Force, new processes, and the use of tools and advanced technology to support their implementation.

Future operations will be characterized by unique, one-of-a-kind actions, with changing/ diverse partners, based on uncertain data and requiring quick response on high impact issues. Characteristics of this new environment include: operations with joint, coalition, non-government, and volunteer organization partners; a shift from extended engagement with a single opponent to local discrete events; dealing with open-source (uncertain, conflicting, partial, non-official) data; rapidly changing team members

and associated organizational structures; culturally diverse partners; and short turn-around, high stakes, politically charged decision making. A series of experiments and exercises is being conducted to help refine the new concepts and processes under development at JFCOM. Each experiment is designed to support assessments of future capabilities and modification of current doctrine, organization, materiel, leadership, and procedures.

DoD KEY TECHNOLOGY AREAS: Other (Information Technology)

KEYWORDS: Network-Centric Operations, Operational Decision Making, Knowledge Wall

ADVANCED COMMAND AND CONTROL (AC2) RESEARCH SUPPORT

William Kemple, Associate Professor
Department of Information Science
Susan Hocevar, Associate Professor
Graduate School of Business and Public Policy
Sponsor: Chief of Naval Operations (N6)

OBJECTIVE: The purpose of this research is to advance our understanding of the implications of network centric operations to command and control. This will be accomplished through an integrated experiment process that links advanced concept seminar-type wargames with simulation-based wargame experiments, OPNAV N6 has identified particular areas of interest to include: Highlight risks and opportunities for C2, explore unintended consequences, identify guiding principals (i.e., Rules, models, metrics), clarify and articulate assumptions and relevant uncertainties.

SUMMARY: Modified human decision-making processes are required—in addition to new tactics and technology that are also currently under development—to enable Joint military forces to operate in a time span that is shorter than an adversary's. Self-synchronization is viewed as an essential process within military organizations that can increase speed of command and thus accelerate execution of the mission. This process of self-synchronization is described as the ability of a well-informed force to organize and synchronize complex warfare activities from the bottom up. The organizing principles are unity of effort, clearly articulated commander's intent, and carefully crafted rules of engagement. Self-synchronization is viewed as a mechanism to overcome the loss of combat power inherent in top-down, command-directed coordination that is characteristic of conventional command and control doctrine. One enabler of self-synchronization is a high level of knowledge of one's own forces, enemy forces, and all appropriate elements of the operating environment. This new style of coordination offers the potential to convert combat from a step function to a high-speed continuum.

An experiment in support of CNO N6C's Advanced Command and Control (AC2) Study was conducted. The objective of the AC2 study is to investigate the nature of command and control as the US Navy evolves toward a network-centric concept of future maritime operations. The focus of the experiment was the conditions (or "enablers") that promote decisionmakers' ability to self-synchronize their efforts. This concept of self-synchronization was examined within the context of a task force responding to time-critical strike and theater air-missile defense missions. An innovative "hybrid" approach that combined concept development seminar games with an experiment process composed of integrated activities, tools, and methods that capitalize on the NPS research team's capabilities, was used to support an area requiring investigation by OPNAV, N6C. A multi-disciplinary approach, including seminar games, models and simulations, interviews, surveys, and other knowledge capture method, matches these methodologies to the requirements of the AC2 study.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communication

KEYWORDS: Command and Control, Modeling and Simulation

RED CELL ANALYSIS OF DISRUPTIVE TECHNOLOGIES IDENTIFICATION OF POTENTIAL ADVERSARY SYSTEMS AND TECHNOLOGIES TO DISRUPT U.S. NAVAL OPERATIONS

John S. Osmundson, Associate Professor
D. C. Schleher, Professor
Department of Information Science
Robert C. Harney, Senior Lecturer
Wayne E. Meyer Institute of Systems Engineering
Sponsor: Naval Warfare Development Command

OBJECTIVE: Assess disruptive technologies that might be employed in the 2015 time frame to deny access to the U.S. Navy. Compare the list of disruptive technologies to and reconcile with U.S. intelligence agencies' assessments.

SUMMARY: This study was directed at identifying and analyzing commercial-off-the-shelf and readily available technologies that might be available to a U.S. adversary in the 2007 to 20015 timeframe to use in a disruptive manner in an anti-access role against U.S. Naval forces. Five dimensions of battlespace were considered: Surface (land and sea), subsurface (land and sea), air, space and cyberspace. Estimates were made of the probability of employment of each of the systems and technologies based on maturity of the systems and technologies, probable costs and development schedules and any other relevant factors. Previous Naval Postgraduate School student area denial study results, published lists of critical technologies, and brainstorming by Naval Postgraduate faculty and systems engineering integration (SEI) students were used as inputs to this study. The approach taken was to encourage "thinking out of the box" rather than relying on observed evidences of potential threats.

Systems and technologies were evaluated in terms of their impact on U.S. forces in an anti-access mode and their probability of occurring. Systems ranked high in both impact and probability of occurrence were analyzed further, where appropriate, to determine estimates of system parameters. Twenty four systems, technologies and attack mechanisms were determined to be high risk to U.S. naval forces. Sixteen systems, technologies and attack mechanisms were found to be medium risk.

PUBLICATIONS:

Osmundsen, J.S, Schleher, D.C. and Harney, R.C., *Identification of Potential Adversary Systems and Technologies to Disrupt US Naval Operations, ANTI-ACCESS SYSTEMS STUDY*, Naval Postgraduate School Technical Report, NPS-JW-01-015, 31 January 2001.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Space Vehicles, Battlespace Environments, Computing and Software, Conventional Weapons, Electronic Warfare, Directed Energy Weapons, Sensors, Surface/Under Surface Vehicles - Ships and Watercraft

KEYWORDS: Red Cell Analysis, Disruptive Technologies

DETECTION OF LPI RADAR SIGNALS

D. C. Schleher, Professor
Department of Information Science
Sponsor: National Reconnaissance Office

OBJECTIVE: To design and synthesize an ELINT receiver capable of detecting LPI radar signals with the same sensitivity as available on equivalent conventional pulsed signals. To accomplish this detection in the presence of a large number of interfering conventional pulsed radars and to measure the radar's mode, allowing the operating range of the LPI radar to be determined.

SUMMARY: An adaptive LPI Radar Detector has been synthesized and successfully simulated. As determined by simulation, it provides an operationally significant range of 60 km on a known LPI radar signal. In addition, it determines the LPI radar's mode. A temporal mask approach is used to allow

detection of the LPI radar signal in the presence of over 500 Furono radars with random modes. An experimental demonstration was successfully conducted that confirmed the theoretical design. The experiment used a threat simulator that radiated synthesized LPI radar signals. The LPI signals were intercepted by a Low Noise Receiver and A/D converter using a 250 MHz Gage Digital Sampling Oscilloscope. The signal was then processed in a digital signal processor using MATLAB code. LPI signals at a level of -108 to -120 dBm were detected and the radar's mode determined.

THESIS DIRECTED:

Teng, H. and Ong, P., "Digital LPI Radar Detector," Masters Thesis, Naval Postgraduate School, March 2001.

DoD KEY TECHNOLOGY AREA: Command, Control and Communication

KEYWORDS: SIGINT, LPI Radar, Digital Pulse Compression, Surveillance

JAMMING TACTICS AND EMPLOYMENT OF UEU AGAINST ADVANCED RADAR AND COMMUNICATIONS SYSTEMS

D. C. Schleher, Professor
Department of Information Science
Sponsor: Navy Information Warfare Activity

OBJECTIVE: Develop UEU employment tactics and advanced jamming techniques to counter communications, data links and advanced J-Band threats.

SUMMARY: A number of advanced threats susceptible to the new UEU jammer capability available in the EA-6B were identified. These include advanced radars using pulse compression and pulsed Doppler type waveforms. Communications jamming is accomplished using the UEU to generate stable narrow band frequency spots with minimum spurious components that prevent interference with friendly communications systems. Data links can be jammed using pulse patterns generated by the UEU. Further research will identify specific waveforms and tactics to exploit the new capabilities available using the UEU.

DoD KEY TECHNOLOGY AREA: Other (Electronic Warfare)

KEYWORDS: EW, Communications Jamming

POSITIONAL ACCURACY OF TDOA MISSILE SYSTEM

D. C. Schleher, Professor
Department of Information Science
Sponsor: Naval Air Warfare Center - Weapons Division

OBJECTIVE: To analyze and synthesize an FDOA/TDOA system capable of providing a 1 m rms position accuracy from telemetry signals radiated from a test missile during flight test. Also, to investigate the accuracy of a Time, Space and Position Information (TSPII) system developed by NAWC Weapons Division, China Lake.

SUMMARY: A lower bound on the accuracy achievable using a nine base station configuration, employed at White Sands Missile Range, as a function of signal-to-noise ratio was determined. The simulation used a missile trajectory determined from measured laser tracker data. The methodology used in the simulation was to determine FDOA from each base station with respect to the reference station and then to use this to determine the TDOA of the missile. This was used in the Smith-Able algorithm to determine the position of the missile. A signal-to-noise ratio of 40 dB was required to achieve a one meter rms positional accuracy of the missile's location. The TSPI system was found to be limited by the susceptibility of the

zero crossing counter to noise and fading and the use of a wideband telemetry signal source in the missile. A system using a stable source in the missile modulated by a pseudo noise code was synthesized. This is currently under investigation using modeling and simulation techniques. An experimental test of this system is planned using a digital receiver approach.

THESIS DIRECTED:

Klaszky, R., "Analysis of the Positional Accuracy of a Range Difference Missile Position Measuring System," Masters Thesis, Naval Postgraduate School, September 2000.

Heng, C., "Kalman Filtering of FDOA/TDOA Missile Tracking System," Masters Thesis, Naval Postgraduate School, March 2001.

DoD KEY TECHNOLOGY AREA: Modeling and Simulation

KEYWORDS: TDOA, FDOA, Missile Location, TSPI, Digital Receiver

DEVELOPMENT OF SOFTWARE RELIABILITY MODEL ENHANCEMENTS

Norman Schneidewind, Professor
Department of Information Science
Sponsor: National Aeronautics and Space Administration - Goddard Space Flight Facility

OBJECTIVE: Develop and implement enhancements to the Schneidewind Software Reliability Model.

SUMMARY: In general, software reliability models have focused on modeling and predicting failure occurrence and have not given equal priority to modeling the fault correction process. However, there is a need for fault correction prediction, because there are important applications that fault correction modeling and prediction support. These are the following: predicting whether reliability goals have been achieved, developing stopping rules for testing, formulating test strategies, and rationally allocating test resources. Because these factors are related, we integrate them in our model. The modeling approach involves relating fault correction to failure prediction, with a time delay between failure detection and fault correction, represented by a random variable whose distribution parameters are estimated from observed data. The contribution is the quantification of the relationship between fault correction delay and reliability goals, which provides the software engineer with information for making informed decisions about meeting reliability goals, developing test strategies, and allocating test resources. In addition, we contribute to the state of the practice by providing a model with both failure detection and fault correction predictions.

PUBLICATIONS:

Schneidewind, N.F., "Modelling the Fault Correction Process," *Proceedings of the Twelfth International Symposium on Software Reliability Engineering*, pp. 185-190, Hong Kong, 27-30 November 2001.

Schneidewind, N.F., "Using Excel to Implement Software Reliability Models," *Notes of the Workshop on Software Assessment, the Twelfth International Symposium on Software Reliability Engineering*, Hong Kong, 27-30 November 2001.

Schneidewind, N.F., "A Roadmap To Distributed Client-Server Software Reliability Engineering," *Tutorial Notes of Quality Week 2001*, San Francisco, CA, 29 May 2001.

Schneidewind, N.F., "Introduction to Software Reliability with Space Shuttle Example," *Tutorial Notes of the 2001 Reliability and Maintainability Symposium*, IEEE Reliability Society, Philadelphia, PA, 23 January 2001.

PRESENTATIONS:

Schneidewind, N.F., "Introduction to Software Reliability Engineering with Space Shuttle Example," Temasek Laboratories, National University of Singapore, 3–4 December 2001.

Schneidewind, N.F., "Software Risk and Maintenance Stability Analysis," Temasek Laboratories, National University of Singapore, 3–4 December 2001.

Schneidewind, N.F., "Everything You Wanted to Know About SRE But Didn't Know Who to Ask", Twelfth International Symposium on Software Reliability Engineering, IEEE Computer Society Press, Hong Kong, 27-30 November 2001.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Software Reliability, Modeling

DEVELOPING THE NEXT GENERATION IEEE DEPENDABILITY STANDARD: IEEE 982 STANDARD DICTIONARY OF MEASURES OF THE SOFTWARE ASPECTS OF DEPENDABILITY

Norman Schneidewind, Professor
Department of Information Science
Sponsor: IEEE Standards Board

OBJECTIVE: Develop an IEEE Software Engineering Standard for Software Dependability.

SUMMARY: This first phase of the project involves the development of measures to address reliability, maintainability, and availability. The second phase will address security, integrity, and confidentiality. This standard builds upon the IEEE 982.1 Standard Dictionary of Measures to Produce Reliable Software, but will delete outdated measures, modernize the standard with object-oriented measures, and modify measures where appropriate. Because 982 was originally issued in 1988 and has not been revised since then, much of it is obsolete. Thus, there is the need to both update existing measures and to include new measures that reflect developments in software technology since 1988. Applying the criteria on how a measure is chosen for inclusion in the dictionary, we have performed a measure-by-measure review and have added, modified, and deleted measures in the dictionary.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Standards, Software Reliability

ESTIMATING AND CONTROLLING SOFTWARE FAULT CONTENT MORE EFFECTIVELY

Norman Schneidewind, Professor
Department of Information Science
Sponsor: Jet Propulsion Laboratory, California Institute of Technology

OBJECTIVE: The goals are to develop techniques that can be used earlier in a development effort to estimate software quality attributes, particularly focusing on the way requirements changes affect software quality, and to identify relationships between specific types of structural changes to a system and the types of faults inserted into it.

SUMMARY: Software metrics have been shown to predict software quality attributes (e.g., reliability, fault content), but most of these measurements taken are of source code. However, they do not help identify the types of faults inserted into software during its development. More effective software quality control depends on the ability of measuring artifacts produced before implementation

The goals were to develop techniques that can be used earlier in a development effort to estimate software quality attributes, particularly focusing on the way requirements changes affect software quality, and to identify relationships between specific types of structural changes to a system and the types of faults inserted into it. These goals were accomplished by developing and publishing models that use requirements change risk factors as predictors of reliability. In addition, the relationship between requirements change risk factors and software metric critical values was modeled. It was shown that when these critical values are exceeded, it is indicative of unreliable software.

PUBLICATIONS:

Schneidewind, N.F., "Life Cycle Core Knowledge Requirements for Software Quality Measurement," *IEEE Computer*, Computer Society Press, Los Alamitos, CA, 2002 (accepted for publication).

Schneidewind, N.F., "Maintenance Process and Product Evaluation Using Reliability, Risk, and Test Metrics," *Advances in Computers*, Academic Press, Vol. 54, pp. 153-181, 2001.

Schneidewind, N.F., "SRE of Web Site Construction," *Tutorial Notes of the Twelfth International Symposium on Software Reliability Engineering*, Hong Kong, 27-30 November 2001.

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Schneidewind, N.F., "Investigation of Logistic Regression as a Discriminant of Software Quality," *Proceedings of the 7th International Software Metrics Symposium*, London, UK, pp. 328-337, 4-6 April 2001.

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Schneidewind, N.F., "Using Excel to Implement Software Reliability Models," *Notes of the Workshop on Software Assessment,* The Twelfth International Symposium on Software Reliability Engineering, Hong Kong, 29 pp., 27-30 November 2001.

Schneidewind, N.F., "A Roadmap To Distributed Client-Server Software Reliability Engineering," *Tutorial Notes of Quality Week 2001*, San Francisco, CA, 20 pp., 29 May 2001.

Schneidewind, N.F., "Introduction to Software Reliability with Space Shuttle Example," *Tutorial Notes of the 2001 Reliability and Maintainability Symposium*, IEEE Reliability Society, Philadelphia, PA, 29 pp., 23 January 2001.

PRESENTATIONS:

Schneidewind, N.F., "SRE of Web Site Construction," Twelfth International Symposium on Software Reliability Engineering, Hong Kong, 27-30 November 2001.

Schneidewind, N.F., "Investigation of the Risk to Software Reliability and Maintainability of Requirements Changes," International Conference on Software Maintenance, Florence, Italy, 7-9 November 2001.

Schneidewind, N.F., "Web Site Maintainability," Seventh Workshop on Empirical Studies of Software Maintenance, Florence, Italy, 9 November 2001.

Schneidewind, N.F., "Requirements Risk Analysis and the AIAA Recommended Practice for Software Reliability," Space 2001 Conference, American Institute of Aeronautics and Astronautics, Albuquerque, NM, 28 August 2001.

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Schneidewind, N.F., "Everything You Wanted to Know About SRE But Didn't Know Who to Ask," Twelfth International Symposium on Software Reliability Engineering, IEEE Computer Society Press, Hong Kong, 27-30 November 2001.

Schneidewind, N.F., "Measuring and Evaluating Maintenance Process Using Reliability, Risk, and Test Metrics," IEEE Computer Society Chapters and Tutorials Program, Greensboro, NC, 19 July 2001.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Software Reliability, Software Metrics, Modeling

MAINTENANCE ERROR INFORMATION MANAGEMENT SYSTEM

George Zolla, Lecturer
Department of Information Science
Sponsor: Federal Aviation Administration

OBJECTIVE: To design a distributed database management system that would capture maintenance factors that have contributed to past aircraft mishaps and make these factors available to users with the goal of reducing future aircraft mishap rates.

SUMMARY: The Human Factors Analysis and Classification System-Maintenance Extension taxonomy (HFACS-ME), a framework for classifying and analyzing the presence of maintenance errors that lead to mishaps, incidents, and personal injuries, is the theoretical foundation for the system. An existing desktop mishap application was updated, a prototype web-based model was developed and an Asynchronous Distributed Learning (ADL) module was conceptualized. These tools were designed to facilitate data collection, organization, query, analysis, and the reporting of maintenance errors that contribute to aviation mishaps. Together they represent a complete, robust system for analyzing aircraft maintenance mishap related factors anywhere at anytime.

PUBLICATIONS:

Zolla, G, Boex, T., Flanders, P. and Nelson, D., "Distributed Maintenance Error Information, Investigation and Intervention," *World Aviation Conference Proceedings*, Seattle, WA, 2001.

Zolla, G., Flanders, P. and Boex, T., "Web-Based Information Management of Maintenance Errors in Aviation Mishaps," *Fourth International Conference on Electronic Commerce Research Proceedings*, Dallas, TX, 2001.

PRESENTATIONS:

Zolla, G., "Distributed Maintenance Error Information, Investigation and Intervention," World Aviation Conference, Seattle, WA, 11-14 September 2001.

Zolla, G., "Web-Based Information Management of Maintenance Errors in Aviation Mishaps," Fourth International Conference on Electronic Commerce Research, Dallas, TX, 8-11 November 2001.

THESIS DIRECTED:

Boez, T., "Web-Based Information Management System for the Investigation, Reporting and Analysis of Human Error in Naval Aviation Maintenance," Masters Thesis, Naval Postgraduate School, September 2001.

Nelson, D., "Information Management System Development for the Investigation, Reporting and Analysis of Human Error in Naval Aviation Maintenance," Masters Thesis, Naval Postgraduate School, September 2001.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Computing and Software

KEYWORDS: Aviation Safety, Maintenance Error Information, Mishap Investigations, Distributed Mishap Information

DEPARTMENT OF INFORMATION SCIENCE

2001
Faculty Publications and Presentations

PUBLICATIONS/PRESENTATIONS

JOURNAL PAPERS

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Schneidewind, N.F., "Requirements Risk Analysis and the AIAA Recommended Practice for Software Reliability," *Proceedings of the Space 2001 Conference*, American Institute of Aeronautics and Astronautics, Albuquerque, NM, 10 pp., 28 August 2001.

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Schneidewind, N.F., "Data Analysis of Software Requirements Risk," *Proceedings of the 12th European Software Control and Metrics Conference*, London, UK, pp. 443-451, 2-4 April 2001.

Zolla, G., Boex, T., Flanders, P. and Nelson, D., "Distributed Maintenance Error Information, Investigation and Intervention," *World Aviation Conference Proceedings*, Seattle, WA, 2001.

Zolla, G., Flanders, P. and Boex, T., "Web-Based Information Management of Maintenance Errors in Aviation Mishaps," *Fourth International Conference on Electronic Commerce Research Proceedings*, Dallas, TX, 2001.

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Schneidewind, N.F., "Measuring and Evaluating Maintenance Process Using Reliability, Risk, and Test Metrics," IEEE Computer Society Chapters and Tutorials Program, Greensboro, NC, 19 July 2001.

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Zolla, G., "Distributed Maintenance Error Information, Investigation and Intervention," World Aviation Conference, Seattle, WA, 11-14 September 2001.

Zolla, G., "Web-Based Information Management of Maintenance Errors in Aviation Mishaps," Fourth International Conference on Electronic Commerce Research, Dallas, TX, 8-11 November 2001.

TECHNICAL REPORTS

Osmundsen, J.S, Schleher, D.C. and Harney, R.C., *Identification of Potential Adversary Systems and Technologies to Disrupt US Naval Operations, ANTI-ACCESS SYSTEMS STUDY*, Naval Postgraduate School Technical Report, NPS-JW-01-015, 31 January 2001.

DEPARTMENT OF INFORMATION SCIENCE

Thesis Abstracts

THE ILLICIT SMALL ARMS TRADE (U)

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Master of Science in Defense Analysis-December 2000
and
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Master of Science in Defense Analysis-December 2000
Advisor: John Arquilla, Information Warfare Academic Group
Second Reader: David Tucker, Command, Control, Communications, Computers, and Intelligence Academic Group

There are a variety of options that must be investigated when attempting to control the illicit Small Arms/Light Weapons (SA/LW) trade. This thesis weighs current control options via an economics-based analytic framework. Currently, solutions focus on three general areas of influence: prevention of production; prevention of sales and purchases; and coercion to relinquish. One can further delineate these areas of influence by looking at how these options could be best implemented-by political/diplomatic, judicial (policing), and/or military means.

There are short and long-term consequences to any actions taken to try to control the illicit SA/LW market. In our opinion, the key to controlling the illicit SA/LW market is two-fold. First, along with today's focus on supply-side options, decisionmakers need to implement demand-side options, such as social reconstruction and economic development. This will remove the security dilemma-peoples' perceived need to maintain weapons for self-protection against internal and external threats. Second, when decisionmakers choose to implement supply-side solutions, they need to keep the market continually in a state of having to react to varied control measures in the short term. This can be done by periodically exposing the SA/LW market to new control measures that force it to constantly do business by different means.

DoD KEY TECHNOLOGY AREAS: Conventional Weapons, Computing and Software

KEYWORDS: Small Arms, Light Weapons, SA/LW, Weapons Trafficking, Counterproliferation, Black Market, Gray Market, Arms Sales

INFORMATION SYSTEMS STRATEGIC PLANNING FOR KOSOVO PEACEKEEPING FORCE

Nuh Altinsoy-First Lieutenant, Turkish Army
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This thesis presents a model of a detailed strategic information plan for a military organization. The model includes the analysis and design of a network and a three-tier client server system. The network analysis focuses on the network traffic flow using Ethernet and Token Ring models. Each candidate technology is simulated with Extend 4.0. Average latency and waiting time in the queue are the simulation parameters. The selection of the candidate technology will play an important role in the implementation of the intranet for the organization.

The three-tier client/server system includes the design and implementation of a relational database, which is connected to the intranet. The database is created with Access 2000. The database connectivity from back-end to front-end is constructed by Active Server Pages (ASP), which enables the users to manipulate the database via their web browsers. The intranet pages are built with Microsoft Front Page 2000. This prototype will permit this organization to initiate a transformation from paper-based environment to the paperless world.

DoD KEY TECHNOLOGY AREAS: Other (Information Technology Management)

KEYWORDS: Strategic Information Plan, Database

POTENTIAL OPERATIONAL APPLICATIONS FOR HIGH POWER MICROWAVES

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This abstract is classified.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications

KEYWORDS: Not Available

DEVELOPMENT OF THE MARINE INFORMATION PORTAL THROUGH INFORMATION MANAGEMENT ON THE WORLD WIDE WEB

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The Marine Information Portal (MIP) research project will systematically develop a Web-based information portal that will support Naval Postgraduate (NPS) Marine students in pursuit of a graduate education. This portal will be based on the precept that the needs of the Marine student community can be better served by the creation of a multifaceted Website geared to their specific information requirements.

The MIP will provide information about the NPS, surrounding communities, professional USMC information, Marine student personal information, and support communication between students, thesis sponsors, the SEP assignment monitor, and the NPS Marine Corps Representative.

The development process will involve planning, requirements identification, design, and implementation. In support of requirement identification, a prototype website with a web-enabled database will be developed, and Marine students will be administered a questionnaire survey. Information will be gathered, consolidated, analyzed, and when appropriate, incorporated into the final site design. The database will include student contact information, as well as thesis information. The database will help enhance student and staff communication, as well as align thesis research with students' follow-on duty assignments. Finally, as a Marine officer, an NPS student, and member of the local community, the NPS Marines will have a Web site primarily focusing on effectively meeting their information needs.

DoD KEY TECHNOLOGY AREAS: Manpower, Personnel and Training

KEYWORDS: Marine Information Portal, MIP, USMC

WEB-BASED INFORMATION MANAGEMENT SYSTEM FOR THE INVESTIGATION, REPORTING, AND ANALYSIS OF HUMAN ERROR IN NAVAL AVIATION MAINTENANCE

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The purpose of this thesis is to examine the development of a Web application to display, analyze, and produce reports of human error involvement and patterns in aviation maintenance mishaps. The Human Factors Analysis and Classification System-Maintenance Extension (HFACS-ME) taxonomy, a framework for classifying and analyzing the presence of maintenance errors that lead to mishaps, is the foundation of this tool. The target audience for this tool includes safety and maintenance personnel, mishap investigators, and safety analysts. A review of five areas is needed to produce the Web-based prototype: (1) client/server architectures, (2) database management systems, (3) Web application design, (4) application coding, and (5) usability considerations for a Web/database tool. Collectively, these topics provided a foundation to develop an effective and user-friendly prototype, referred to as HFACS-ME Web. A usability study was conducted using potential end-users. The participants were given both written procedures to navigate through the prototype and an exit survey. The results of the survey, including objective and subjective responses, indicate strong user support for the HFACS-ME Web prototype in concept and implementation and suggest that the training and analysis capability it provides may contribute to a reduction in maintenance errors and ultimately a decreased mishap rate.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Computing and Software

KEYWORDS: Human Factors Analysis and Classification System-Maintenance Extension, HFACS-ME, Aviation Mishaps, Maintenance Errors

USER-CENTERED ITERATIVE DESIGN OF A COLLABORATIVE VIRTUAL ENVIRONMENT

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Most tasks that are desirable to train in a virtual environment are not tasks that we do alone, but rather are executed collaboratively with one or more team members. Yet little is known about how to construct virtual environment training systems that support collaborative behavior. The purpose of this thesis was to explore methodologies for developing collaborative virtual environments for training. The approach centered on analyzing task or training specific requirements for the simulation environment. User-centered design techniques were applied to analyze the cognitive processes of collaborative wayfinding to develop interface design guidelines. The results of our analysis were utilized to propose a general model of collaborative wayfinding. This model emphasizes team collaboration and interaction in problem solving and decision-making. The model in the field, using cognitive task analysis methods to study land navigators. This study was intended to validate the use of user-centered design methodologies for the design of collaborative virtual environments. Our findings provide information useful to design, ranging from model enhancement to interface development. The cognitive aspects of collaborative human wayfinding and design for collaborative virtual environments have been explored. Further investigation of design paradigms should include cognitive task analysis and behavioral task analysis.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Human Systems Interface, Modeling and Simulation

KEYWORDS: Virtual Environments, Wayfinding, Collaboration, Land Navigation, Virtual Reality, User-Centered Design

DESIGNING A RELATIONAL DATABASE TO FACILITATE MILITARY FAMILY HOUSING UTILIZATION DECISIONS

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Second Reader: LTC James E. Illingworth, USA, TRADOC Analysis Center Monterey

The Housing Welcome Center (HWC) in Monterey, CA manages more than 2,200 military family houses and provides services to approximately 4,500 service members. The current housing information system consists of a proprietary legacy database system, a homemade non-relational database, a collection of word processing documents, and a static online application Web site. This semi-manual system can introduce errors, inconsistencies, and redundancies that may lead to frustration and possibly a decrease in quality of life.

This research presents a prototype Housing Assignments and Terminations System (HATS) that uses a top-down systems analysis design approach. The research defines requirements and models that are transformed into a relational database with connectivity to a Web site. A graphical user interface (GUI) provides intuitive menus to manipulate and view data. Decision support tools help decision-makers visualize the data in a spatial manner and make better decisions to improve the quality of life for service members.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: GIS, Legacy System, Decision Support Tools, Military Family Housing, Relational Databases

AN EXAMINATION OF INDIVIDUAL INFLUENCES ON HONOR CONCEPT VIOLATORS AT THE U.S. NAVAL ACADEMY

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The purpose of this research is to examine the factors that increase the likelihood of midshipmen to commit violations of the Naval Academy's Honor Concept. Specifically this research examines whether, while accounting for other factors, midshipmen who are admissions exceptions (low test scores, etc.) more frequently commit honor violations.

DoD KEY TECHNOLOGY AREA: Manpower, Personnel, and Training

KEYWORDS: Naval Academy, Honor Concept, Honor Code, Midshipmen, Cheating, Honor

DEVELOPMENT OF AN RF WEAPON USING OPEN SOURCE INTELLIGENCE

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The world's increasing reliance on computers and electronics has made the employment of radio frequency (RF) weapons against electronic systems an attractive concept. Electromagnetic interference (EMI) effects from RF radiation are well known. Recent advances in high-power microwave (HPM) technology and the increasing commercial availability of conventional RF sources have made the development of such systems for other than scientific pursuits not only feasible, but probable.

This thesis explores the technical requirements, costs, and timelines necessary to build such a system. It documents the processes that a team of "non-experts" undertook to design and build a microwave transmitter capable of disrupting unshielded electronic systems. The researchers investigated how to design and build a viable RF weapon capable of use in terrorist applications on a limited budget, with no external guidance from HPM experts, and using only open source information and Commercial-Off-The-Shelf (COTS) technology. This work documents useful sources of information, the development of a preliminary system design, the acquisition of components, and planning for system fabrication, component modification, and integration into a disguised mobile platform.

DoD KEY TECHNOLOGY AREAS: Electronics

KEYWORDS: Electromagnetic Interference, EMI, High Power Microwave, HPM, Unshielded Electrical Systems

INTEGRATION OF THE USMC AAAV(C) C4I SYSTEM ARCHITECTURE AND STAFF TRAINING REQUIREMENTS

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The Advance Amphibious Assault Vehicle (AAAV) is new technology and it has the potential to change the way the Marine Corps conducts amphibious and mechanized operations. The AAAV(C) is the command variant and its primary mission is to provide a Command and Control (C2) platform capability to the battalion and regiment level. The command, control, communications, computers, and intelligence C4I system to be employed on the AAAV(C) is making use of the latest technology in computer hardware and software, radio communications, and wireless data transfer.

In order to take advantage of this robust system, the user is going to need to be trained. The more experienced and familiar the user is with the applications, the better they can assist the commanding officer in exercising C2 over the battlefield. The training of the staff officer is essential and must start early. In this thesis several additions to current USMC training requirements have been identified and recommended for inclusion in future training courses.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications

KEYWORDS: Command and Control, C2, Advanced Amphibious Assault Vehicles, AAAV, Command Variant

SURVEY OF EMERGING WIRELESS/PCS TECHNOLOGY AND THE IMPLICATIONS ON FUTURE MILITARY TACTICAL COMMUNICATIONS

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This research evaluates the wireless technologies that are currently available in the commercial sector or that are in development. The objective is to evaluate the suitability of using the technologies as a viable communication vehicle for the United States Marine Corps, specifically for use by the Intelligence and Information Operations communities. Subjects addressed include cellular/personal communications services (PCS) technology currently available and in development. Also included are potential applications by the USMC, strengths and limitations as they relate to Intelligence and Information Operations, and relationships of cellular and PCS technologies. As a final point, recommendations for categorization of cellular/PCS technologies by radio frequency spectrum and wireless service are incorporated.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications

KEYWORDS: Intelligence, Information Operation, Cellular/Personal Communications Services, PCS, Military Tactical Communications

IMPLEMENTATION CONSIDERATIONS FOR A VIRTUAL PRIVATE NETWORK (VPN) TO ENABLE BROADBAND SECURE REMOTE ACCESS TO THE NAVAL POSTGRADUATE SCHOOL INTRANET

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As broadband connections to the home become more prevalent, through Digital Subscriber Lines (DSL) and cable modems, students and faculty will desire to access the NPS intranet via these new means instead of their 56K modems. The introduction of these new technologies will require NPS to re-evaluate how to allow remote access to their internal resources in a secure way, while still allowing for the use of broadband technologies.

This thesis will examine the alternative methods for implementing Virtual Private Networks (VPNs), from simple use of Point to Point Protocols (PPP) to high end specialized internet appliances and gateways. Pros and cons of each will be discussed. A mock-up of the school's network will be created to test each of the discussed methods. Final recommendations will be made for a model that can be used by the NPS to implement a VPN. Also discussed will be how that model may be altered to fit other commands throughout the U.S. Navy who desire similar secure remote access to their internal network resources.

It should be noted that the thesis will concentrate on remote secure access to an internal network from a single remote host more than on the VPNs' additional ability to remotely connect two or more secure networks together, such as can be found in a business to business (B-to-B) environment.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Virtual Private Network (VPN), Remote Access, Public Key Infrastructure (PKI), Broadband Access, and Computer Security

COMPARISON OF DEPARTMENT OF DEFENSE INFORMATION TECHNOLOGY ACQUISITION PROCESSES: A CASE STUDY

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This thesis presents a comparison and analysis of two Department of Defense (DoD) acquisition methods: the formal acquisition process and the Advanced Concept Technology Demonstration (ACTD). Both processes can be, and are, used by DoD to acquire information technology (IT), but while DoD has utilized the formal acquisition process for 30 years, the ACTD process is only six years old, and was specifically designed to improve upon the standard acquisition process (when applied to IT). By describing and studying the events surrounding, actors participating in, and results of one ACTD, this thesis will determine what lessons-learned can be applied to the standard acquisition process. While the ACTD and acquisition processes share some similarities in their management and funding, there are also significant differences. For example, ACTDs gain approval through a completely different process than acquisitions, and are subjected to less bureaucratic oversight. The recommendations provided in this thesis indicate that, based upon the experiences of the real-life ACTD sampled, the ACTD process does represent an improvement upon the standard acquisition process, specifically when the standard process is utilized to acquire IT.

DoD KEY TECHNOLOGY AREAS: Other (Acquisition)

KEYWORDS: Acquisition, Information Technology, Advanced Concept Technology Demonstration, ACTD

BUSINESS PROCESS REDESIGN IN MARINE CORPS RECRUITING WITH VISUAL MODELING AND SIMULATION

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The goal of the thesis is to identify information flow tasks in the current Marine Corps enlisted recruiting system presenting an opportunity for gains in efficiency through the application of information technology. This thesis presents an overview of the recruiting process, including the mission, target market, players, and business rules. The recruiting business model is decomposed into its components, and information flow through each component is further examined. Graphic models are created using Extend™ visual modeling and simulation software to establish a direct labor cost-per-task measure for the current or "As Is" system. "As Is" data are generated and recorded for each of the information flow tasks to be evaluated. Considering applications of information technology that may improve information flow tasks, future or "To Be" models are applied to the respective tasks and data are collected and recorded. Cost-per-task data for the "As Is" and "To Be" models are compared, and potential efficiencies gained are noted. The results of the comparison show that significant gains in efficiency are possible by applying information technology solutions to reduce redundant data entry and other burdensome administrative tasks.

DoD KEY TECHNOLOGY AREAS: Manpower, Personnel and Training, Modeling and Simulation

KEYWORDS: USMC Recruiting, Recruiting Process

ORGANIZATIONAL STRUCTURE FOR INTER-AGENCY INFORMATION OPERATIONS

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and
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COL Thomas H. Gerblick, United States Army

The purpose of this thesis is to stimulate a discussion toward developing an all-encompassing Inter-agency Information Operations organization. The authors define an environment and identify theories that point toward the necessity of integrating Information Operations (IO) throughout the U.S. Government (USG). The authors explore the feasibility of establishing and empowering an inter-agency organization that will monitor, evaluate and enforce all aspects of IO.

Early forms of IO and its' deployment are depicted in the historical backdrop of World War II. Concepts of renown futurists identify the importance of the Information Age and the essential process to maximize its' full potential. A correlation between the current national security strategy and the IO environment strongly suggests the need for innovation.

An overview of the current IO environment and USG organizations reveal a technological move toward inter-agency IO. Both the art and science sides of IO are incorporated into a new organization. OrgCon 7.0 is used to analyze the proposed IO organizational structure, which provides specific recommendations and defines misfits that must be addressed. The authors conclude that further work is required in modeling the organization via alternate software and a more in depth look is required in the area of national security IO. The authors provide the essential groundwork for further research.

DoD KEY TECHNOLOGY AREAS: Command, Control, and Communications, Materials, Processes and Structures, Other (Information Operations)

KEYWORDS: Information Operations, Interagency, Interdepartmental, Organization, OrgCon, National Security

THE EFFECTIVENESS OF CLASS AND ETHNICITY IN MOBILIZING RESOURCES FOR TERRORISM

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Second Reader: Rodney K. Minott, Department of National Security Affairs

This thesis attempts to determine which of two terrorist groups, an ideologically based group (Red Brigades) and an ethnically based group (ETA or Basque Fatherland and Liberty), is more effective at mobilization. Mobilizing human resources is the method by which terrorist groups sustain their levels of membership. Without sustained or growing levels of membership, the group declines and soon ceases to exist. By determining a group's effectiveness at mobilization, judgments can be made on the likelihood of the group experiencing continued mobilization leading to continued operations or experiencing demobilization leading to decline.

The ETA is still a functioning terrorist group whereas the Red Brigades has ceased to exist. A possible explanation is the ETA was more effective than the Red Brigades at mobilizing resources. After explaining the theory of mobilization, this thesis will apply the theory to the two groups. A subsequent comparison of the two groups' effectiveness at mobilizing resources will enable a judgment to be made on which group is more effective at mobilization. By demonstrating that the ETA was more effective than the Red Brigades

at mobilizing people, this thesis will give an explanation for the survival of the ETA and the decline of the Red Brigades.

DoD KEY TECHNOLOGY AREA: Other (Terrorism)

KEYWORDS: Terrorism, Mobilization, Red Brigades, ETA

RECOMMENDING POLICY AND OPERATING PROCEDURES FOR STEALTHY INTRUSION DETECTION NETWORKS (SIDN) IN THE DEPARTMENT OF THE NAVY

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Stealthy Intrusion Detection Networks (SIDNs) are useful tools that assist computer security professionals improve computer network defense (CND.) There have been questions as to whether or not the Department of the Navy can conduct SIDN research and if so what are appropriate uses for the data and with whom can DoN share it. The goal of the thesis is to explore existing laws pertaining to operating SIDN, and their relevant policies. This thesis analyzes the three entities currently conducting honeynet research in the United States and presents recommended operating procedures and policy for Department of the Navy honeynets including interaction with civilian authorities.

The conclusions drawn from this research indicate that DoN can lawfully conduct the research and recommends methods for interacting with law enforcement and incident handling.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Stealthy Intrusion Detection Networks, SIDN, Computer Network Defense, CND, Computer Security

A NAVAL SPECIAL WARFARE CONCEPT OF OPERATIONS FOR THE MOBILE EXPLORATION SYSTEM (MEX) IN A NETWORK CENTRIC ENVIRONMENT

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The development of wireless local area networks (WLANs) has greatly accelerated the commercial development of wireless technology for enterprise network solutions. Government and military organizations are also benefiting from the competition and interoperability fostered by the new marketplace. Given the decreasing cost, and increasing capabilities of WLANs, military units could soon adopt commercial WLANs as the networks of choice for combat operations. This trend will facilitate the realization of Network Centric Operations (NCO).

Wireless technology availability, coupled with the U.S. military's trend of looking to commercial-off-the-shelf (COTS) communication and computing solutions, necessitate an awareness of the characteristics of WLANs. The capabilities of the WLAN technology will influence the Concept of Operations (CONOPS).

This thesis researches and conducts an analysis of a mobile WLAN at the NASA Ames Research Center in Moffett Field, California, called the Mobile Exploration System (MEX), developed as a test bed for future planetary exploration concepts. This thesis determines the types of WLAN technologies that could be implemented in Naval Special Warfare (NSW) operations in a network centric context and

proposes a CONOPS. Finally, the thesis provides a cost-benefit framework for analyzing the application of WLAN technologies to NSW mission areas.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Mobile Exploration System, MEX, Wireless Technology, Wireless Local Area Networks

FEASIBILITY OF THE TACTICAL UAV AS A COMBAT IDENTIFICATION TOOL

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Soldiers maneuvering on the 21st Century battlefield are issued state-of-the-art equipment. Despite this, the tools at their disposal to identify targets as being a "friend" or a "foe" have changed little since Operation Desert Storm. While improved optics on late model combat systems are extending gunners' abilities to identify targets at extended ranges, an optics-vs-ballistics gap remains in the majority of U.S. Army ground maneuver forces. This gap, and other battlefield factors, increases the likelihood of fratricides in combat.

This thesis examines the feasibility of using the Army's Tactical Unmanned Aerial Vehicle (TUAV) as a combat identification (CID) tool for troops at the tactical level. Three scenarios were modeled and multiple simulations run to identify potential problems in using the TUAV as a CID tool, as well as ways to improve the system if it is used in this role. Model considerations included current and planned future datalink bandwidths, system delays, normal vs. immediate taskings, and travel times to mission areas.

The thesis demonstrates that if TUAVs are properly integrated into tactical mission planning and imagery analysts possess the necessary level of vehicle identification training (to include thermal identification training), the TUAV can function well as a CID tool.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: Tactical Unmanned Aerial Vehicle, TUAV, Combat Identification, CID

USING ON-LINE ANALYTICAL PROCESSING AND DATAMINING TO ESTIMATE EMERGENCY ROOM ACTIVITY IN DOD MEDICAL TREATMENT FACILITIES IN THE TRICARE CENTRAL REGION

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On-line Analytical Processing (OLAP) and datamining can greatly enhance the ability of the Military Medical Treatment Facility (MTF) emergency room (ER) manager to improve ER staffing and utilization. MTF ER managers use statistical data analysis to help manage the efficient operation and use of ERs. As the size and complexity of databases increase, traditional statistical analysis becomes limited in the amount and type of information it can extract. OLAP tools enable the analysis of multi-dimensional data, which can give the user access to previously undiscovered information. Data mining has the capability to break large sets of data down into groups by classifications, associations, and clusterings to transform previously meaningless data into useful information.

This research presents a brief overview of the DoD medical system, OLAP, and datamining. OLAP and datamining tools then analyze a data set containing two years of MTF ER data from the TRICARE Central Region. The results of these analyses provide insight on the predictive capabilities, advantages, and disadvantages of applying OLAP and datamining to MTF ER data.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: On-Line Analytical Processing (OLAP), Data Mining, Medical Treatment Facility (MTF), Emergency Room

HIGH ALTITUDE LONG ENDURANCE (HALE) PLATFORMS FOR TACTICAL WIRELESS COMMUNICATIONS AND SENSOR USE IN MILITARY OPERATIONS

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United States military forces are transitioning to network centric operations, as described in Joint Vision 2010 and Joint Vision 2020. Warfighting elements will function as individual nodes in a global information grid with an end-to-end infrastructure that provides information on demand to warfighters, policymakers, and support personnel. This transition will place additional demands on wireless communications and Intelligence, Surveillance, and Reconnaissance (ISR) systems. However, current and planned space-based communications solutions are costly and have significant shortfalls. Likewise, ISR systems will have difficulty fulfilling near real-time requirements and sensor-to-shooter roles. One possible solution is through the use of emerging stratospheric platforms. In the area of communications and ISR support, this thesis; reviews the Services' doctrines and future warfighting needs, identifies available space-based systems along with their shortfalls, and defines support capabilities from the stratospheric environment. It then provides an in-depth review of emerging high altitude long endurance (HALE) platforms, analyzes HALE platforms survivability, provides a concept of operations (CONOPS) for HALE employment, and performs a HALE platform comparative analysis.

DoD KEY TECHNOLOGY AREAS: Sensors, Command, Control and Communications

KEYWORDS: Wireless Communications, ISR, Intelligence, Surveillance and Reconnaissance, Sensor-to-Shooter, High Altitude Long Endurance, HALE

ENHANCING NETWORK COMMUNICATION IN NPSNET-V VIRTUAL ENVIRONMENTS USING XML-DESCRIBED DYNAMIC BEHAVIOR (DBP) PROTOCOLS

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The existing component protocols, as well as new protocols introduced at runtime into NPSNET-V are written in their native programming language. As a result, they require authoring and compiling by a trained programmer. The long time frame required to change or introduce new protocols into NPSNET-V, a dynamically extensible virtual environment, detracts from the dynamics of the virtual environment. Networking optimization thresholds to support NPSNET-V needed to be determined to ensure that the networking is performed efficiently, and system resources to other systems, such as graphics rendering, are maximized. This thesis implements component protocols described using Extensible Markup Language (XML) into NPSNET-V. These protocols are created with different fidelity resolutions for each protocol, which can be swapped at runtime based on the network state. Network testing was performed to find the

ideal maximum packet rates based on the impact on CPU utilization and packet loss. By using XML, non-programmers can edit protocols for inclusion in a simulation at runtime.

Important contributions include adding protocols to NPSNET-V with high-resolution and low-resolution versions, described by XML documents. Basic network optimization is added to NPSNET-V to take advantage of the protocols' resolution switching ability. The network testing revealed a linear correlation between the packet sending rate and CPU utilization, and a polynomial correlation between the packet sending rate and percentage packet loss.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: NPSNET-V, Virtual Environments, XML-Described Dynamic Behavior, DBP

INFLUENCE NET MODELING: THE NARCOTICS NETWORK IN COLOMBIA

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The purpose of this thesis is to conduct the research necessary to develop a situational influence assessment model to identify critical indicators that will assist the USSOUTHCOM in identifying potential key centers of gravity in the fight against illicit drug production and narcotrafficking in Colombia. Efforts to combat the narcotics network directly support the USSOUTHCOM mission and are integral to U.S. National Security. Unlike the traditional military threats of the Cold War and previous decades, to include Operation Desert Storm, this problem set is far more complex and complicated with roots and foundations that date back to the development of Colombia as a nation-state. It is the strategic dilemma that is posed by this asymmetric threat that reflects the type of problems that will be encountered by the military of the 21st century. Unlike the traditional land/sea/air combined warfare that the U.S. dominates globally, the threats of the 21st century will look much like Colombia - small, packetized, networked organizations with the ability to operate and inflict casualties below the threshold of our traditional military mechanisms. Improved decision support systems to model this type of problem are needed. This thesis suggests a number of modifications to an existing model, SIAM, in order to enhance its usefulness both for decision makers and intelligence collectors.

DoD KEY TECHNOLOGY AREA: Other (Information Operations, Intelligence Information Management)

KEYWORDS: Information Operations, Intelligence, Decision Support Systems, Influence Net Modeling, Colombia

DESIGN OF MOBILE USER OBJECTIVE SYSTEM (MUOS) HELMET MOUNTED UHF ANTENNA

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The Mobile User Objective System (MUOS) is the Navy's next generation narrowband tactical communication system that will provide a significant increase in capacity and link availability to

disadvantaged users, including handheld terminals. Future MUOS antennas will have a receive band of 243 MHz - 270 MHz and a transmit band of 292 MHz - 317 MHz with a voltage standing wave ratio (VSWR) of less than three across both bands. Additionally, the antenna must have a nearly omni-directional radiation pattern above 10 degrees in elevation, be conformal to a US military helmet and have a low profile. In this thesis an antenna was designed that is capable of operating over the entire band 243 MHz to 317 MHz. The antenna performance was optimized for its design restrictions. The antenna was designed and its performance predicted using Ansoft's High-Frequency Structure Simulator (HFSS). The HFSS is based on the Finite-Element Method (FEM).

DoD KEY TECHNOLOGY AREAS: Electronics, Computing and Software

KEYWORDS: Mobile User Object System, MUOS, Tactical Communication System, UHF Antenna

CORRELATION ANALYSIS OF FLEET INFORMATION WARFARE CENTER NETWORK INCIDENTS

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The Navy's Intrusion Detection process is currently reactive in nature. It is designed and programmed to detect and provide alerts to the Fleet Information Warfare Center (FIWC) of suspicious network activity while it is in progress, as well as, to record/store data for future reference. However, the majority of activity taking place within and across Naval networks is legitimate and not an unauthorized activity. To allow for efficient access and utilization of the information systems sharing the network the Intrusion Detection Systems must be set at a level that filters out activity deemed as normal or non-hostile, while still providing an appropriate level of security. With this filtering in place an IDS system will not register all suspicious activity, and may not detect mild and seemingly harmless activity. When increasing security, limits must be imposed upon access. This thesis examines FIWC network incident data from 1999 to see if a correlation can be drawn between United States visibility in the foreign media during 1999 and the occurrence of suspicious network incidents. A positive correlation may provide advance-warning indicators that could lead to the development of a procedure for increasing security posture based on the current environment. These indicators would provide a more proactive method of defense, significantly reduce potential damage caused by hostile network incidents and provide for more efficient network activity.

DoD KEY TECHNOLOGY AREAS: Other (Information Technology)

KEYWORDS: Fleet Information Warfare Center, Intrusion Detection, Network Incidents

NAVY/MARINE CORPS INTRANET INFORMATION ASSURANCE OPERATIONAL SERVICES PERFORMANCE MEASURES

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Communicating in the Department of the Navy (DON) over the Internet is an everyday event. The DON is developing the Navy Marine Corps Intranet (N/MCI) to enhance this communication capability. The security of communicating over the N/MCI has become a concern to the DON. The DON is relying on the N/MCI contractor to provide security for their communications. Key aspects of this secure communication will be provided through the use of a DON Public Key Infrastructure (PKI), which the N/MCI contractor is

managing. To ensure the security of the PKI based communications the contract requires the monitoring of four PKI performance measures. This thesis analyzes performance measures, criterion, and standards then uses this analysis to review the contractual PKI performance measures and data collected from commercial PKI vendors. It recommends changes to these performance measures and provides additional performance criteria that should be included in the N/MCI contract. Finally, this thesis analyses how the N/MCI contract, specifically the PKI, impact DON members.

DoD KEY TECHNOLOGY AREA: Computing and Software, Other (Public Key Infrastructure)

KEYWORDS: Public Key Infrastructure, Public Key Cryptography, Navy Marine Corps Intranet, Service Level Agreements, Performance Measures, PKI, N/MCI

SEMANTIC INTEROPERABILITY IN AD HOC WIRELESS NETWORKS

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Ad hoc wireless networks are decentralized networks whose members join and leave the network in an asynchronous manner and for short periods of time. Each node participating in the network acts both as host and a router

Ad hoc networks in theory, support missions of the Armed Forces in situations in which the infrastructure for wire-bound networks is not dependable, it is impractical to build and maintain the infrastructure, or the missions requires that the nodes have a high-degree of mobility.

Ad hoc wireless networks require some level of semantic interoperability so that nodes in the network can "understand" each other. In this thesis, requirements for semantic interoperability in ad hoc wireless networks are discussed, and a case study is presented of how such requirements could be applied. It was realized during the study that semantic interoperability components and functions are developed mostly for wired networks, and not taking in consideration the wireless issues such as processing, power, and networking limitations. In this thesis, wireless user infrastructure, mobile middleware, and wireless application protocols as a solution to realize semantic interoperability in wireless ad hoc networks are discussed.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications, Computing and Software

KEYWORDS: Ad Hoc Networks, Routing Protocols, Semantic Interoperability, Wireless Networking

VULNERABILITY ASSESSMENT THROUGH PREDICTIVE MODELING OF IEEE 802.11 STANDARD WIRELESS LOCAL AREA NETWORKS

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The development of the IEEE 802.11 standard for wireless local area networks (WLANs) has greatly accelerated the commercial development of wireless technology for enterprise network solutions. Government and military organizations are also benefiting from the competition and interoperability fostered under the international standard. Given the decreasing cost, and proliferation of wireless networking technology, organizations are foregoing the expansion of cumbersome ethernet networks, and turning to cheap, available wireless architectures to augment data communication and processing needs.

Wireless technology availability coupled with the U.S. military's trend of looking to commercial-off-the-shelf (COTS) communication and computing solutions necessitate an awareness of the characteristics of WLANs. The argument for research is bolstered when considering how the ease of implementation and low system maintenance costs make it probable that second or third world entities at odds with US interests may use COTS wireless technology. Should the U.S. confront adversaries that have integrated command and control circuits consisting of WLANs, or come under attack from groups that know how to exploit our own, it will be necessary to have analyzed WLAN characteristics.

This thesis intends to research the current industry technology and standards driving WLAN interoperability, and determine which vendor's components are likely to be seen in world markets. Finally, the thesis will analyze a WLAN communications link at NPS to determine feasibility of emissions/intercept field mapping using a modular software and hardware suite.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications, Computing and Software, Electronics, Electronic Warfare, Sensors, Other (Wireless LANs)

KEYWORDS: Wireless Local Area Networks, IEEE 802.11, Exploitation, Vulnerability, Link Analysis, Radio Propagation, Network Security, Information Operations

USING OPERATIONAL RISK MANAGEMENT (ORM) TO IMPROVE COMPUTER NETWORK DEFENSE (CND) PERFORMANCE IN THE DEPARTMENT OF THE NAVY (DON)

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Operational Risk Management (ORM) has been credited with reducing the Navy's mishap rate to all time lows, especially in Naval Aviation. Through the use of a five-step process, ORM has been able to change the decisionmakers' paradigm of day-to-day operations in naval fleet units, making safety the paramount factor that would allow fleet commanding officers to conserve their assets, yet meet the requirement to train in high-risk environments. ORM is a process that mitigates the risk associated with the high-risk environment that naval fleet units operate in.

Not unlike naval fleet units, our computer networks operate in a high-risk environment-the Internet. Crackers are able to penetrate what were thought to be secure networks, and copy, modify, disrupt or destroy valuable information. The risk posed to the Navy's computer network systems is very great. Given the Navy's adoption of "Network-Centric Warfare" and the Navy-Marine Corps Intranet (NMCI), the hazards faced by the possible compromise of these computer network systems are as great as any a fleet unit would encounter in its normal operating environment.

The objective of this thesis is to translate ORM practices into Information Assurance Risk Management (IARM) practices, and demonstrate IARM's utility in identifying, quantifying, and mitigating the security risks associated with computer networks.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Computer Network Defense (CND), Operational Risk Management (ORM), Critical Infrastructure Assurance, Information Assurance Risk Management (IARM), Information Security Policy and Information Assurance

INFLUENCE NET MODELING: THE NARCOTICS NETWORK IN COLOMBIA

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The purpose of this thesis is to conduct the research necessary to develop a situational influence assessment model to identify critical indicators that will assist the USSOUTHCOM in identifying potential key centers of gravity in the fight against illicit drug production and narcotrafficking in Colombia. Efforts to combat the narcotics network directly support the USSOUTHCOM mission and are integral to U.S. National Security. Unlike the traditional military threats of the Cold War and previous decades, to include Operation Desert Storm, this problem set is far more complex and complicated with roots and foundations that date back to the development of Colombia as a nation-state. It is the strategic dilemma that is posed by this asymmetric threat that reflects the type of problems that will be encountered by the military of the 21st century. Unlike the traditional land/sea/air combined warfare that the U.S. dominates globally, the threats of the 21st century will look much like Colombia - small, packetized, networked organizations with the ability to operate and inflict casualties below the threshold of our traditional military mechanisms. Improved decision support systems to model this type of problem are needed. This thesis suggests a number of modifications to an existing model, SIAM, in order to enhance its usefulness both for decision makers and intelligence collectors.

DoD KEY TECHNOLOGY AREAS: Other (Information Operations, Intelligence Information Management)

KEYWORDS: Information Operations, Intelligence, Decision Support Systems, Influence Net Modeling, Colombia

COMPUTER NETWORK DEFENSE: A SURVEY OF NETWORK TRACING TECHNIQUES

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With the growth of the Internet, the World Wide Web, and digital networks throughout the Department of Defense (DoD), the amount of information and resources available nearly instantaneously greatly impacts operations within DoD and each service. Because of this impact, the reliability, integrity and availability of data has become critical to the success of the Department's mission. As part of the security posture of DoD, a layered defense is integrated into its digital networks, which is implemented as a passive measure to meet DoD's security needs. These defenses, however, are able to identify the origin of attacks only after traditional investigative techniques are employed. This thesis looks at al of the research being conducted in academia, in the commercial sector, and within the government to address the traceback problem, the means to identify an attacker's Internet source location via automated methods.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications, Computing and Software, Sensors, Other (Computer Security, Information Operations)

KEYWORDS: Traceback, CNA, CNE, CND, Network Security, DNO, IO

3D VISUALIZATION OF TACTICAL COMMUNICATIONS FOR PLANNING AND OPERATIONS USING VIRTUAL REALITY MODELING LANGUAGE (VRML) AND EXTENSIBLE 3D (X3D)

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The military is increasingly reliant on communication networks for day-to-day tasks as well as large-scale military operations. Tactical communications networks are growing progressively more complex as the amount of information required on the battlefield increases. Communication planners require more advanced tools to perform and manage signal-planning activities. This work examines the use of 3D visualizations to assist in tactical signal planning. These visualizations are developed using Virtual Reality Modeling Language (VRML), Extensible 3D (X3D) graphics, and Distributed Information Simulation (DIS) for network connectivity.

These visualizations and the connectivity provide signal planners the ability to generate 3D scenarios quickly identifying problems such as frequency interference, connectivity problems, and marginal-coverage areas. Network connectivity also provides a collaborative planning environment for geographically dispersed units.

The NATO Global Hub Land C2 Information Exchange Data Model (LC2IEDM) is a semantic model designed for information passing between systems. This work also examines LC2IEDM for its ability to represent tactical communication plans and facilitate the autogeneration of 3D scenarios.

DoD KEY TECHNOLOGY AREAS: Command, Control, Communications, Modeling and Simulation

KEYWORDS: 3D Visualizations, Virtual Reality Modeling Language (VRML), Extensible 3D (X3D), Tactical Communications, Communications Planning, NATO Global Hub, Land C2 Information Exchange Data Model (LC2IEDM)

INTEGRATION OF PERSONAL DIGITAL ASSISTANT (PDA) DEVICES INTO THE MILITARY HEALTHCARE CLINIC ENVIRONMENT

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The business drivers within managed care are mandating that physicians have point-of-care access to medical reference data, patient specific data, formularies, treatment protocols, and billing/coding information. One emerging technology that has the potential to provide this access with little economic investment is the mobile Personal Digital Assistant. The authors address a variety of wireless technologies and security concerns regarding real-time access to patient data. The family practice staff at the Naval Hospital Lemoore explored and contrasted the capabilities of commercially available PDAs, wireless interfaces, and medical software applications to ascertain their value within the Military Health System. A production-ready interface between the Composite Health Care System and the Nutrition Management Information Server demonstrates the potential for eliminating the difficulties associated with documenting

patient encounters and capturing charges. Survey tools generate a requirements standard for deployment of this technology within the Military Health System on an enterprise-wide scale with a hybrid approach to packaging based on functionality. The authors recommend the Military Health System embrace this technology as a means to realize its vision of best value health services.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Wireless Technologies, Military Healthcare, Military Health System

MODELING INFLUENCES ON NUCLEAR WEAPONS DECISION MAKING BY PAKISTAN USING THE SITUATIONAL INFLUENCE ASSESSMENT MODEL PROGRAM

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Since Pakistan's inception in 1947, when the British carved it out of the western region of India, Pakistan and India have fought three wars and even now coexist in a permanent state of tension. Since 1998, both nations have declared their nuclear status, creating a risk of nuclear war in any future conflict. Low-level skirmishes between Indian and Pakistani forces along the Line-of-Control (LOC) in the disputed state of Kashmir are a regular occurrence, providing the most likely scenario for full-scale warfare to erupt between India and Pakistan. Further, the disparity of conventional forces between India and Pakistan (India enjoys a 2:1 conventional force superiority over Pakistan) has spurred Pakistan's nuclear program, and provides significant impetus for Pakistan to resort to first use of nuclear weapons. Pakistan views their nuclear weapons as both a deterrent and a force multiplier.

Utilizing a computer program known as Situational Influence Assessment Module (SIAM), an influence net model is constructed to ascertain the likelihood of Pakistan using nuclear weapons against India. The model is used to examine U.S. Central Command's (CENTCOM) Theater Engagement Plan (TEP) goals and whether or not the TEP effectively targets the key influences identified in the model.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Modeling and Simulation

KEYWORDS: Pakistan, Nuclear Weapons, Modeling and Simulation, SIAM, Information Warfare, Perception Management

EXPERIMENTATION METHODOLOGY FOR EVALUATING OPERATIONAL INFOCON IMPLEMENTATIONS

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Information Operation Condition (INFOCON) implementations and specifically the impact these implementations can have on warfighting command and control processes are not yet widely understood or appreciated by the majority of the operating forces. INFOCON actions are designed to heighten or reduce defensive posture uniformly, to defend against computer network attacks, and to mitigate sustained damage to the DoD infrastructure. Experimentation is required to explore the effects on certain command and control processes under various INFOCON conditions. This thesis explored requirements for conducting

these INFOCON experiments and resulted in the development of an INFOCON experimental design methodology that can be used as a framework for designing and conducting INFOCON experiments in the field. INFOCON experimentation will provide insights and a better understanding of the effects that these implementations will have on the ability of a commander to command and control his or her forces.

DoD KEY TECHNOLOGY AREA: Command, Control and Communications

KEYWORDS: Information Operation Condition (INFOCON), Experimentation, Network Centric Warfare the Global Broadcast Service (GBS), a global system of satellites providing a high speed broadcast service of video and data, for transferring large METOC data products from FNMOC to METOC regional centers around the world.

A DATA WAREHOUSING AND OLAP APPLICATION FOR THE NAVAL RESERVE FORCE (CNRF) ASSESSMENT PROCESS

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The Naval Reserve Force has identified a need to pool the data from its many legacy database systems into a single, useable data warehouse. The current system uses separate legacy databases and formatted reports to provide a manual decision process. Under the leadership of Rear Admiral John Totushek, the Naval Reserve Force is driving many technological revolutions via the Leading Change initiative. One of the key goals of the Leading Change initiative is a strategic decision support tool. To support this goal, Naval Reserve Force Assessment Division elected to fund a project to provide a prototype data warehouse and Online Analytical Processing (OLAP) solution to the problem. The Naval Reserve Strategic Decision Support Tool (NaRSDAT) is the result. The NaRSDAT development of this thesis provides an in depth evaluation of the existing databases. It then provides an object oriented development approach to a relational data warehouse and a star schema development for data mining. NaRSDAT employs Microsoft Visual Basic, Microsoft Access, and Cognos PowerPlay to provide a complete data warehouse and OLAP solution. The NaRSDAT prototype will serve as the basis for a comprehensive knowledge management solution for the Naval Reserve Force.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Manpower, Personnel and Training

KEYWORDS: On-line Analytical Processing, OLAP, Naval Reserve Strategic Decision Support Tool, NaRSDAT, Data Warehouse

MODELING MEDIA INFLUENCES IN INFORMATION OPERATIONS

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Military engagements are disruptive and expensive, draining economic and natural resources. As a result, military strategists, particularly in the nuclear age, seek to deter aggressive actions by historical and emerging challengers. Strategies that employ inexpensive, unobtrusive means to dissuade adversaries from aggressive action are particularly desirable.

Steady globalization and the concurrent rise of international media presence provide a promising, and perhaps overlooked, means for influencing adversary decision-making. Through a detailed case study, this paper provides a framework for leveraging media influences as an integral part of a broad deterrent strategy. Among the findings, the researchers discuss the expected complications and intricacies associated with implementing such an effort, as well as demonstrate how influence new modeling techniques can assist in identifying target audiences. The criticality of considering associated socio-cultural, historical, and geo-political contexts is also explored.

DoD KEY TECHNOLOGY AREAS: Other (Information Operations)

KEYWORDS: Information Operations, Media Influences, Deterrent Strategy

KALMAN FILTERING OF FDOA/TDOA MISSILE TRACKING SYSTEM

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The accuracy of a tracking system designed to determine the time, space and position information (TSPI) of an airborne missile by detecting its telemetry signal at a number of receiver sites is investigated. Doppler frequency measurements are converted to range differences between the missile and receiver sites, whose locations are known in three dimensions. An algorithm then utilizes these range differences to obtain the missile TSPI. The accuracy of the TSPI is a function of the measurement precision and the signal-to-noise ratio at the receiver sites.

This thesis examines the characteristics of the TSPI accuracy and investigates how a Kalman Filter can be used to enhance the accuracy of the TSPI.

DoD KEY TECHNOLOGY AREA: Sensors

KEYWORDS: Kalman Filter, Range Difference of Arrival (RDOA), Time Difference of Arrival (TDOA), Frequency Difference of Arrival (FDOA)

INTRUSION DETECTION SYSTEMS REQUIREMENTS ANALYSIS: AN EVALUATION OF THE MARINE CORPS' USE OF COTS IDS

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Intrusion detection systems (IDS) have become a major tool in the defense of computer networks throughout DoD. However, in the past, the purchase of these tools has been based on little more than vendor literature. This thesis applies Joseph Barrus' requirements model to the current Commercial-Off-The-Shelf (COTS) IDS deployed on the Marine Corps Enterprise Network (MCEN) and determines if the current IDS meets the Marine Corps' requirements. To make this determination, this thesis looks at three questions: what are the requirements for an intrusion detection system, how are those requirements measured and can they be measured? This thesis also looks at the MCEN in detail and concludes that the centralized control and management of the MCEN allows the Marine Corps to use other resources to make-up for the deficiencies of an average COTS product. Lastly, the thesis addresses the state of intrusion detection standards and certified evaluations of IDS. Standardization, when approved, gives the Marine Corps more flexibility in selecting security products that complement the MCEN operating environment. Certified evaluations by accredited laboratories ensure that companies and organizations can purchase

security products with a greater degree of confidence that they will function according to an established assurance level.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Intrusion Detection Systems, IDS, Marine Corps Enterprise Network, MCEN

THE ANALYSIS, DESIGN, AND IMPLEMENTATION OF THE DEFENSE MANPOWER DATA CENTER PAY DATA WAREHOUSE

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This thesis discusses a five step methodology for developing a data warehouse: data model development, defining data sources, data cleansing and integration, populating the warehouse, and providing query access. Specifically, it describes how those steps were employed to design and implement a Department of Defense (DoD) Pay Data Warehouse for the Defense Manpower Data Center (DMDC).

The objective was to define the requirements needed to implement a data warehouse that would be used to store and report on Active Duty Pay, Reserve Pay, DoD Civilian Pay, and Military Retired Pay data as submitted to DMDC by the Defense Finance and Accounting Service (DFAS) and the Coast Guard Pay and Personnel System. Using database technologies, Computer Aided Software Engineering (CASE) tools, and Query and Report tools, a Pay Data Warehouse was designed and slated for implementation and integration with an already designed Personnel Data Warehouse.

The design and implementation of the Pay Data Warehouse will improve the data quality, standardization, and data access procedures for DMDC. As a result, data requests submitted of the twenty-year-old archives will be executed more efficiently and return more accurate data than is currently possible.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Other (Data Warehouse)

KEYWORDS: Data Warehouse, Database, Data Warehouse Development Methods, Defense Manpower Data Center

A COMMUNICATION LINK SOFTWARE MODEL FOR FLEET NUMERICAL METEOROLOGY AND OCEANOGRAPHY CENTER

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This thesis develops and provides an accurate simulation model of the communications pathway between Fleet Numerical Meteorology Oceanographic Center (FNMOC), Monterey, California and Naval Atlantic Meteorology Oceanographic Center (NLMOC), Norfolk, Virginia. In order to fulfill its mission to provide global weather forecasts to the warfighter, FNMOC must provide timely data to its customers. This model provides an analytic approach toward determining time delay with respect to bandwidth and its management. Additionally, this model enables the user to analytically determine the effects of hardware changes. Although other customers exist besides FLMOC, it is a major customer of data files in support of weather forecasting. The other major links are located in Rota, Spain; San Diego, California; Yokosuka, Japan; and Pearl Harbor, Hawaii. This model however, is scalable to simulate these other major links. The

target audience for this information model is the technical support personnel at FNMOC Monterey, California, who manage the link with NLMOC Norfolk, Virginia. The information that supports this model was derived from field visits to technical personnel at FNMOC Monterey. No other communications software model has been developed at the present time. The discrete event software simulation tool used for this model is ExtendTM.

DoD KEY TECHNOLOGY AREAS: Battlespace Environments, Computing and Software, Modeling and Simulation

KEYWORDS: Model, Simulation, Network, Bandwidth, Meteorology, ExtendTM

REORGANIZATION OF THE MARINE AIR COMMAND AND CONTROL SYSTEM TO MEET 21ST CENTURY DOCTRINE AND TECHNOLOGY

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The Marine Air Command and Control System (MACCS) is at a crossroad for organizational change. New and emerging war fighting doctrine, which places an emphasis on joint and small contingency operations, as well as new technology, requires that the MACCS review how it is organizationally structured. Within the next few years, the Marine Corps will field the Common Aviation Command and Control System (CAC2S). CAC2S is designed to be a singular tactical system for all functional agencies within the Marine Air Control Group (MACG). Unique systems, which were in the past tailored for the specific missions, will be eliminated with the fielding of CAC2S. CAC2S will allow the MACCS to operate in a manner that could not be achieved when the MACCS was first formed during the 1960s. Many sources in the Fleet Marine Force and the support establishment recognize that the MACCS must reorganize in order to operate and function effectively within the confines of this emerging 21st century technology and doctrine. Parallels exist between how industry and business reorganize when introduced to new technologies and business doctrine, and the military. Organizational restructuring is something that must be carefully considered and planned, for it is most often resisted by the members and stakeholders of an organization. Overcoming the barriers and resistance to change requires formal models of change be implemented. Technology alone cannot increase or improve an organization's productivity. Only through formal restructuring can an organization such as the MACCS hope to remain essential to the mission of the Marine Corps.

DoD KEY TECHNOLOGY AREAS: Other (Organizational Change)

KEYWORDS: Marine Air Command and Control System, MACCS, Common Aviation Command and Control System, Organizational Change, Organizational Restructuring

INFORMATION MANAGEMENT SYSTEM FOR ELECTRONIC VOTING IN SUPPORT OF THE SCHIEFFELIN AWARD FOR EXCELLENCE IN TEACHING

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The purpose of this research was to evaluate, automate, refine and develop a management information system that facilitated data collection, organization, query, analysis, and counting of ballots submitted over the Internet/Intranet with regard to the Rear Admiral John J. Schieffelin Award for Excellence in Teaching. Research included conducting a detailed analysis of the current system (re-engineering), preparing

hardware and software requirements for an automated system, determining security requirements for an Intranet based voting system and implementing a prototype to demonstrate feasibility. The "Rear Admiral John J. Schieffelin Award for Excellence in Teaching" has traditionally been a manual system interwoven with several legacy systems that make analysis, voter response and data collection difficult. Development of an Internet/Intranet based information system coupled with a decision support system for statistical analysis, streamlines the flow of information, thus allowing for more robust analysis/querying as well as possibly increasing voter response by providing a friendly user interface that allows quick and easy ballot submissions.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Data Collection, Information Management System

DYNAMIC ASSEMBLY FOR SYSTEM ADAPTABILITY, DEPENDABILITY AND ASSURANCE (DASADA) PROJECT ANALYSIS

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This thesis focuses on an analysis of the dynamic behavior of software designed for future Department of Defense systems. The DoD is aware that as software becomes more complex, it will become extremely critical to have the ability for components to change themselves by swapping or modifying components, changing interaction protocols, or changing its topology. The Defense Advanced Research Programs Agency formed the Dynamic Assembly for Systems Adaptability, Dependability, and Assurance (DASADA) program in order to task academia and industry to develop dynamic gauges that can determine run-time composition, allow for the continual monitoring of software for adaptation, and ensure that all user defined properties remain stable before and after composition and deployment. Through the study, a review of all the DASADA technologies were identified as well as a thorough analysis of all 19 project demonstrations.

This thesis includes a template built using the object-oriented methodologies of the Unified Modeling Language (UML) that will allow for functional and non-functional decomposition of any DASADA software technology project. In addition, this thesis includes insightful conclusions and recommendations on those DASADA projects that warrant further study and review.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Computing, Software, Software Engineering, Software Demonstration

VULNERABILITIES ASSOCIATED WITH REMOTE ACCESS TO TIMESTEP VIRTUAL PRIVATE NETWORKS (VPNs)

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As Marine Corps requirements for Internet access continue to increase, so do the concerns about network security. One of the key components in the Marine Corps network security architecture is the employment of TimeStep Virtual Private Network (VPN) products to protect the Marine Corps Enterprise Network (MCEN). These VPN products provide security through authentication, confidentiality, and data integrity. Remote access to the MCEN via TimeStep VPNs provides the flexibility, security, and global connectivity required in today's high operations tempo.

Despite the benefits TimeStep VPNs provide to deployed users, the risks associated with remote access remain unclear. In this thesis, the author begins by identifying and evaluating vulnerabilities associated with remote user access to TimeStep VPNs via dial up modems, cable TV modems, and Digital Subscriber Lines (DSL). After the vulnerabilities have been identified, the author proposes policies and procedures that can mitigate these vulnerabilities. The aim of this study is to provide systems administrators and remote users of the MCEN useful insights into the threats that exist when using TimeStep VPNs and assistance in lessening their impact.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Virtual Private Networks, Computer Network Attack, Computer Security, Computing and Software, Network Security

THE EMPLOYMENT OF A WEB SITE AND WEB-ENABLING TECHNOLOGY IN SUPPORT OF U.S. MILITARY INFORMATION OPERATIONS

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As a global-based system of information systems, the World Wide Web has the potential to support U.S. Military Information Operations. Presently, there is a lack of established U.S. Military Doctrine or Planning Guidance on how to incorporate the use of a website in support of Information Operations (IO). This thesis proposes suitable uses of a web site within the IO arena as defined by Joint Military Doctrine. Specifically, it is proposed that a web site can support all of the following type of activities: public information, civil affairs, psychological operations, deception and intelligence collection. In addition, the U.S. commercial marketing sector is advantageously employing recent advances in Information Technology and software which have yielded web-enabling features such as interactivity, personalization, customization, and dynamic information publishing, to name a few. The U.S. military can learn a great deal from this. This thesis describes some recent web-enabling technology and then provides a first approximation at mapping web-enabling features to IO capabilities. One product of this thesis is a first approximation of a planning checklist to be used by IO practitioners and web-site developers when considering the use of a web-based IO. Although technology will continue to change, this planning checklist provides a template for integrating web-enabling features within IO.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Information Operations, Website, Web-enabling Technology, Personalization, Dynamic Information Publishing

MAINTENANCE ERROR INFORMATION MANAGEMENT SYSTEM (MEIMS) UPGRADE AND TRAINING EVALUATION

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The purpose of this thesis is to study the usability of an upgraded Maintenance Error Information Management System (MEIMS) tool used to capture human error in Naval Aviation maintenance mishaps. Built upon the Human Factors Analysis and Classification System-Maintenance Extension taxonomy, the tool provides the framework for examining maintenance errors that lead to mishaps, incidents, and personal injuries. The tool is developed for safety personnel, mishap investigators, Aircraft Mishap Board members, and analysts. In limited usability testing, the tool was found to be useful, but in need of revisions, specifically regarding functionality and user friendliness. Additionally, a tutorial is provided to better prepare targeted users of the tool. The study requires a review of mishap information systems, human error theories related to aviation mishaps, design considerations for human-computer interfaces and usability study applications. A follow-on usability study, conducted using two groups of potential users, one which received the tutorial and one which did not. It includes a survey regarding subjective responses about the prototype tool. The results indicate that the tutorial is effective in preparing and assisting potential users, and that the tool could make a significant impact in the reduction of mishap rates due to maintenance error.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Human Systems Interface, Manpower, Personnel and Training

KEYWORDS: Aviation Accidents, Aviation Mishaps, Accident Classification, Maintenance Mishaps, Maintenance Error, Human Factors, Human Error, Naval Aviation, Trend Analysis, Information Management System

INFORMATION SECURITY REQUIREMENTS FOR A COALITION WIDE AREA NETWORK

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To achieve information superiority in a coalition environment the U.S. has to seamlessly integrate coalition members, both NATO and Non-NATO, into its command and control processes along all echelons of military operations. In a coalition environment, it is extremely challenging to fuse multinational information systems to achieve seamless integration. This thesis focuses on the security issues that are involved in establishing coalition network interoperability. The coalition environment is defined in terms of purpose, command structure, mission area, and control functions. Network and information protection are discussed in terms of minimizing the threats to information systems security. Coalition information system user requirements are defined and some of the security mechanisms required to meet those requirements are discussed. Current solutions to secure coalition network interoperability are surveyed, followed by conclusions, recommendations and areas for further study.

DoD KEY TECHNOLOGY AREAS: Battlespace Environment, Command, Control, and Communications, Other (Information Assurance)

KEYWORDS: Battlespace Environment, Command, Control, and Communications (3), Information Assurance

COLLABORATIVE PLANNING SOLUTIONS: USING USMC STANDARD COLLABORATION TOOLS TO ASSIST WITH MISSION PLANNING AND EXECUTION

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This study provides a baseline on collaborative solutions and tools. This thesis examines the current collaborative applications used within the United States Marine Corps (USMC). It demonstrates the strengths and weaknesses inherent to the current collaborative tool set used within the USMC. Additionally, this research examines how collaborative applications can effectively enhance information sharing during mission planning and execution, as well as increase productivity. A key to efficient planning and execution today is to find a seamless application that is standard throughout the entire Marine Corps and that is easy for the users to embrace. Findings indicate that collaborative tools can be highly effective if properly applied to the correct process. Recommendations for the future include finding a Web-based, data-driven application such as Microsoft Sharepoint Portal Server 2001. It combines the ability to easily create corporate Web portals with document management, enterprise content indexing, and team collaboration features.

DoD KEY TECHNOLOGY AREAS: Other (Information Technology Management)

KEYWORDS: Collaborative Solution and Tools, Planning, Web Portals, Document Management

EFFECTIVENESS OF MODELING A HIGH POWER RADIO FREQUENCY (HPRF) WEAPON SYSTEM (U)

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The objective of this research was to model the electromagnetic output of a proposed High Power Radio Frequency (HPRF) weapon system. The antenna data was generated using GNEC, a method of moments computational electromagnetic code. The impulsive excitation and resultant transient near-fields were modeled using electrical circuit analysis and inverse Fast Fourier Transformation programmed in MATLAB 5.3. The peak amplitudes and waveforms were the primary focus of this study

DoD KEY TECHNOLOGY AREAS: Electronics Warfare, Directed Energy Weapons, Modeling and Simulation

KEYWORDS: Electronic Warfare, Directed Energy Weapons, Antenna Design, Antenna Modeling, Electromagnetic Simulation

DIRECTED ENERGY: APPLICATIONS AND VULNERABILITIES (U)

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Much has been made in recent years of the potential for directed energy (DE) to be used as a weapon, and of U.S. vulnerability to such modes of attack. This thesis surveys the current status of laser, high-power microwave, particle beam, and acoustic technology to answer two primary questions. First, what sorts of tactical DE weapons can be fielded in the next 10 years? Second, if developed, what sort of threat would these systems pose to the U.S.? Conclusions assess potential applications and threats of DE weapons in the next ten years and suggest areas for further research.

DoD KEY TECHNOLOGY AREA: Directed Energy Weapons

KEYWORDS: Directed Energy, LASER, High-Power Microwave, Radio Frequency, Particle Beam, Acoustic, Weapon

ORGANIZATION DESIGN PRINCIPLES FOR COUNTERING TERRORISM IN THE UNITED STATES

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Recent terrorist activities (the World Trade Center bombing, the Oklahoma Federal Building bombing, the release of Sarin Gas in the Tokyo subway, etc.) have focused the national leadership on the topic of terrorism inside the borders of the United States. In response, two Presidential Decision Directives (PDD-62 and PDD-63) were issued to help define the terrorist threat and recommend a counter-terrorism organization in the federal government. However, the directives do not determine how the Federal government works with state and local authorities. The directives also do not focus on local, state, and federal capabilities to preempt a possible terrorist attack. This thesis builds a organizational framework of the U. S. counter-terrorism environment; explains the current U. S. counter-terrorism structure from a local perspective; develops a set of principles that could be used by any local or federal agency to develop a new or more efficient counter-terrorism organization; assesses two domestic counter-terrorism organizations; and proffers specific recommendations on how U. S. counter-terrorism organizations and programs could be more efficient.

DoD KEY TECHNOLOGY AREAS: Other (Organization Design)

KEYWORDS: Counter-Terrorism Environment, Organizational Framework, Counter-Terrorism Organizations

LESSONS FROM ENTERPRISE SYSTEM IMPLEMENTATIONS APPLIED TO THE MARINE CORPS TOTAL FORCE ADMINISTRATION SYSTEM

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The United States Marine Corps is implementing a new human resource system called the Total Force Administration System (TFAS). Enterprise and Enterprise Resource Planning (ERP) System implementations are reputed to be difficult because of the problems encountered by corporate America in the late 1990s. This thesis conducted a review of corporate enterprise system implementations looking for commonality in two areas: the most frequent problems encountered and key success factors. This thesis provides the TFAS leadership with issues of concern that require greater attention or research and with key success factors for the TFAS implementation. This thesis also reviewed and analyzed the preliminary architecture for the TFAS project. By leveraging the lessons learned from other implementations, it is hoped to increase the chances of success for this project and minimize implementation pain.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Total Force Administration System, TFAS, Enterprise System

USING KNOWLEDGE MANAGEMENT TO INNOVATE USCG COMMAND CENTER PROCESSES

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The U.S. Coast Guard (USCG) responds to thousands of alerts received each year from the Search and Rescue Satellite-Aided Tracking (SARSAT) system. Each alert requires an efficient and effective response to assist a potential mariner in distress. This thesis provides an in-depth analysis of the process employed by USCG Command Centers in responding to SARSAT alerts. The purpose of this analysis is to identify alternatives that can improve the knowledge work performed in the process. This thesis builds on recent work that focuses on knowledge management and system design from three integrated perspectives: 1) reengineering, 2) expert systems knowledge acquisition and representation, and 3) information systems analysis and design. The integrated framework covers the gamut of design considerations from the enterprise process at large, through alternative classes of knowledge in the middle, and on to specific systems in detail. The SARSAT response process is examined using this integrated framework and identifies five technological and organizational alternatives that offer significant potential to improve the overall performance of the process.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications, Other (Knowledge Management)

KEYWORDS: Knowledge Management, Process Analysis, Process Re-engineering, Information Systems

USING NETWORK MANAGEMENT SYSTEMS TO DETECT DISTRIBUTED DENIAL OF SERVICE ATTACKS

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Distributed Denial of Service (DDoS) Attacks have been increasingly found to be affecting the normal functioning of organizations causing billions of dollars of losses. Organizations are trying their best to minimize their losses from these systems. However, most of the organizations widely use the Network Management Systems (NMS) to observe and manage their networks. One of the major functional areas of a NMS is Security Management. This thesis examines how the Network Management Systems could aid in the detection of the DDoS attacks so that the losses from these could be minimized. The thesis details the SNMP MIB variables of importance for detecting these attacks and the MIB signatures of the specific attack.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Distributed Denial of Service, DDoS, Network Management Systems, NMS, MIB, SNMP

INFORMATION MANAGEMENT SYSTEM DEVELOPMENT FOR THE INVESTIGATION, REPORTING, AND ANALYSIS OF HUMAN ERROR IN NAVAL AVIATION MAINTENANCE

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The purpose of this research is to evaluate and refine a safety information management system that will facilitate data collection, organization, query, analysis and reporting of maintenance errors that contribute to Naval Aviation mishaps, equipment damage and personnel injury using OPNAV 3750.6R, Human Factors Analysis and Classification System Maintenance Extension taxonomy. The target audience for this information management system tool included safety personnel, mishap investigators, Aircraft Mishap Board (AMB) members, and analysts. A review of three areas was needed to refine the prototype tool: (1) the collection, use and management of accident information, (2) human error theories as related to aviation mishaps and (3) the design of an effective mishap database tool. A usability study was conducted using potential end-users. Fifteen Naval Aviation Safety Officers and Naval Aviators were given written procedures to navigate through the prototype and an exit survey. The survey responses, including objective and subjective responses about the prototype were gathered. The results indicate, that with proper training, the prototype could provide insight into maintenance errors, which could be used to target hazards and develop intervention strategies to prevent future mishaps.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Air Vehicles

KEYWORDS: Safety Information Management System, Naval Aviation Mishaps, Naval Aviators, Aircraft Mishap Board, AMB

SCENARIO AUTHORING AND VISUALIZATION FOR ADVANCED GRAPHICAL ENVIRONMENTS (SAVAGE)

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Today's planning and modeling systems use two-dimensional (2D) representations of the three-dimensional (3D) battlespace. This presents a challenge for planners, commanders, and troops to understand the true nature of the battlespace. This thesis shows how 3D visualization can give both operation planners and executors a better understanding of the battlespace that can augment today's 2D systems. Automatic creation of a 3D model for an amphibious operation allows the planner to view an operation order as a whole, from different perspectives. Recommended changes can be made and their effects immediately known. Warfighters can use the same tools for mission preparation and review.

The United States and NATO nations use the Land C2 Information Exchange Data Model (LC2IEDM), formally known as the Generic Hub, as a common method for exchanging data between independent systems. As part of the Scenario Authoring and Visualization for Advanced Graphical Environments (SAVAGE) project, this research presents an integrated Web access and 3D visualization strategy for Department of Defense (DOD) tactical messaging and operation orders using the Generic Hub data model and the Extensible Markup Language (XML). A number of alternative yet consistent ways to represent an amphibious operation scenario demonstrate the power, flexibility and scalability of the SAVAGE approach.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation, Computing and Software

KEYWORDS: SAVAGE, 3-D Battlespace, LC2IEDM, XML, Visualization

EMERGENT LEADERSHIP ON COLLABORATIVE TASKS IN DISTRIBUTED VIRTUAL ENVIRONMENTS

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Several Department of Defense agencies are currently investigating the use of distributed collaborative virtual environments (CVE) for the training of small dismounted infantry teams. If these systems are to be successful, they will have to do more than simply allow the team members to execute a task. In addition to assuring that essential training in the CVE transfers to the real task, it must be ensured that aspects of team organization also transfer. In particular, this thesis investigates whether or not predicted emergent leadership, as measured by standardized personality tests, holds within a CVE or if aspects of the interface interfere.

For a given "real-world" task domain a leader can be predicted based on personality traits of the individuals within the group. The interface utilized with a CVE may adversely affect these traits. In other words, predictive measures of leadership in the real world may not hold in a CVE.

The study reported here will use this predictability to identify the expected emergent leader within a group and determine how the CVE interface affects the ability of the predicted individual to emerge as the leader. It is theorized that the limitations of CVE interfaces (field of view, realism, etc.) will negatively impact the transfer of leadership personality traits into the virtual environment, but not to a degree that the limitation cannot be overcome. These limitations may impact the group dynamics and the emergent leader may not necessarily be the predicted leader by personality traits.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation

KEYWORDS: Collaborative Virtual Environments, CVE, Virtual Environments

AN ARCHITECTURE AND PROTOTYPE SYSTEM FOR AUTOMATICALLY PROCESSING NATURAL-LANGUAGE STATEMENTS OF POLICY

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Organizations are policy-driven entities. Policy bases can be very large and complex; these factors are compounded by the dynamic nature of policy evolution. Thus, comprehension of the ramifications of both policy modification and assurance of the consistency, completeness, and correctness of a policy base necessarily requires some level of computer-based support.

A policy workbench is an integrated set of computer-based tools for developing, reasoning about, and maintaining policy. A workbench takes as input a computationally equivalent form of policy statements. In this thesis, approaches for translating natural-language policy statements into their equivalent computational form with minimal user interaction are explored. The architecture of a natural-language input-processing tool (NLIPT) is presented, which was designed to augment a policy workbench. NLIPT components consist of an extractor, index-term generator, structural modeler, and logic modeler.

Experiments were with a prototype of the extractor. The extractor successfully parsed twenty-seven of a sample of ninety-nine of U.S. Department of Defense security policy statements. An additional twenty-one statements were correctly parsed based on the syntactic structure of the input.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Command, Control, and Communications, Human Systems Interface

KEYWORDS: Natural-language Processing, Policy, Security, Formal Methods

POTENTIAL VULNERABILITIES OF A USMC TACTICAL WIRELESS LOCAL AREA NETWORK

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As part of the ongoing Revolution in Military Affairs, the Navy and Marine Corps are engaged in an ambitious effort to integrate emerging technologies into new operational concepts. The vision of future conflict places heavy emphasis on highly mobile forces that will require unprecedented cooperation between forces afloat and ashore. These new operational concepts, such as Operational Maneuver From the Sea (OMFTS), require new technologies to give small combat units unmatched situational awareness ultimately leading to greater combat power. The Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration has sought to demonstrate new advances in joint expeditionary warfare significantly aided by a commercial-off-the-shelf wireless communications system.

This thesis examines potential vulnerabilities of the ELB wireless local area network. Specifically, it explores the impact such vulnerabilities may have on the eventual ability of supported units to accomplish their mission in an OMFTS-type scenario. The vulnerabilities are divided between the two network layers defined by the commercial standard, the physical and MAC layers. This study concludes that there are considerable vulnerabilities at both network layers, the most significant for a military application, however, are those associated with the physical layer and therefore alternate physical layer solutions should be sought for tactical wireless networks of the future.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: RMA, Extending Littoral Battlespace, ELB, Joint Expeditionary Warfare, Operational Maneuver From the Sea, OMFTS, Wireless LAN

THE GUNFIGHTER'S DILEMMA: MULTIPLE ADVERSARY DETERRENCE AND COERCION

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Throughout history great powers have had to wrestle with the problem of maintaining their influence over the world around them. Often these powers were simultaneously faced with more than one opponent. In order to meet multiple challenges, leading nations have had to maximize the number of potential adversaries they could influence with each action or policy.

Those faced with this dilemma have included the Romans, Byzantines, and the British Empire. Studying these nations in their struggle to maintain control revealed tactics and techniques that proved effective. Forward deployment, statements of perseverance, the use of coalitions, strategic distraction of opponents, and the demonstration of their relative superiority over adversaries all helped to preserve the longevity of these empires. Additionally, an effective information campaign, which amplified successes, proved invaluable to these world powers.

This thesis explores how a single action often affects more than just the two parties taking and receiving action. It then discusses the flow of how the information content of foreign policy actions transfers from the primary actor to multiple secondary actors. Historical cases of multi-adversary deterrence and coercion are used as models of how this hypotheses, coupled with a good information strategy, maximized the studied powers' effectiveness.

DoD KEY TECHNOLOGY AREA: Other (Information Operations)

KEYWORDS: Deterrence, Coercion, Information Operations

DEMOCRATIZATION IN BOSNIA: A MORE EFFECTIVE ROLE FOR THE MILITARY

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Since the end of the civil war in 1995, the United States and the world community have poured enormous amounts of money and resources into Bosnia and Herzegovina in an attempt to create a sustainable peace for all of Bosnia's citizens based on the principles of democratic governance. But at times, it seems that although the fighting has stopped the country is no closer to being a functioning, stable democracy than it was when the multi-national intervention force first arrived more than five years ago.

This thesis examines democracy theory and the democratization process to provide an explanation for why the international effort has been unsuccessful so far, and explores alternative ways to address some of those shortcomings. This thesis argues that the Stabilization Force (SFOR) has the ability to be a more effective partner in fostering consolidated democracy in Bosnia. It concludes by identifying military capabilities such as civil affairs, Special Forces and intelligence collection that could directly contribute to successful democratization.

DoD KEY TECHNOLOGY AREA: Other (Democratization)

KEYWORDS: Bosnia, Conflict Resolution, Conflict Suppression, Democratization, IFOR, SFOR, Stabilization

USING MULTIPLE COLLABORATIVE AGENTS FOR ADAPTIVE QUALITY OF SERVICE MANAGEMENT OF C4ISR NETWORKS

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This research explores the potential of agent technology for adaptive quality of service (QOS) management of c4isr networks. With the growing emphasis on information superiority, any time savings or additional utilization of resources enabled by effective network management becomes increasingly important. Intelligent agents are ideal for assessing information, adapting to dynamic conditions, and predicting future network conditions. In the kernel of the proposed multiple agent system (MAS) testbed are agent shared memory and majority rule architectures for agent conflict resolution. The case based reasoning (CBR) technique provides the foundation for building the agents' shared memory of qos management solutions and allows the individual agents to share their associations of feedback controls in response to application and user qos profiles. Based on the telecommunications management network (TMN) functionality, we use this agent architecture to effectively translate the warfighter's service layer application requirements across the network. The fundamental frameworks of service level management (SLM) and policy based management (PBM) serve as cornerstones in effectively gathering and applying specific application requirements. Finally, we utilize these techniques to investigate an actual C4I application at the pacific region network operating center (PRNOC) in Wahiawa, Hawaii as the real-world focal point of the thesis.

DoD KEY TECHNOLOGY AREA: Command, Control, and Communications

KEYWORDS: Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR), Agent Technology, Quality of Service (QoS), Case Based Reasoning (CBR), Service Level Management (SLM), Policy Based Management (PBM), Telecommunications Management Network (TMN)

QUALITY OF SERVICE FOR IP-BASED NETWORKS

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In recent decades, the networking community has been looking for strategies to converge over a single common network infrastructure carrying voice, video and data. The pervasive and ubiquitous packet-based

IP network provides the most convenient platform for the desirable convergence, where resources can be managed in an efficient and dynamic manner.

The gradual convergence into the IP infrastructure introduces multimedia-rich and interactive applications that are bandwidth-intensive and delay-bound, while more sophisticated data applications are deployed that place new demands onto IP networks. The IP-based network is evolving to satisfy the requirements of traffic differentiation and reliable service. Quality of Service (QoS) mechanisms are introduced to meet the traffic expectations and enhance the basic service model of the network in many subtle ways.

This thesis provides a comprehensive examination of QoS mechanisms and protocols that have surfaced to optimize the utilization of network resources, to provide differentiated treatment of traffic and enforce the appropriate policies. The study proposes a balanced approach of bandwidth increase and integration of robust QoS techniques into existing IP network infrastructure to arrive at a convergent, multiservice and scalable telecommunications network. Findings from this thesis can be incorporated into the design and implementation of an integrated network within a large organization that will deliver accurate services and defined levels of performance.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Command, Control, and Communications

KEYWORDS: Networking, Convergence, Quality of Service, IP Multi-Service Network, Policy-based Network, Traffic Management

VULNERABILITY ASSESSMENT OF WIRELESS DATA NETWORK SIGNAL TRANSMISSIONS

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The abstract is for official use only.

DoD KEY TECHNOLOGY AREA: Command, Control, and Communications

KEYWORDS: Wireless LAN, Wireless Bridge, IEEE 802.11, IEEE 802.16

BUSINESS ARCHITECTURE MODEL FOR NETWORK CENTRIC SURFACE COMBATANT LAND ATTACK WARFARE

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Land attack is a major mission area for the surface navy in the coming years. High levels of complexity characterize the land attack environment of 2015. The purpose of this research is to generate an understanding of the warfare architecture the land attack C4ISR-T systems will support. The Business Architecture Model for Network Centric Surface Combatant Land Attack Warfare depicts a networked resource structure of sensor, weapons, and decision makers that are transformed in a value added engagement process to achieve land attack goals. This structure was developed using the Eriksson-Penker Business Extensions Tool Kit for the Unified Modeling Language (UML). The Eriksson-Penker Business View comprises the Business Vision, the Business Structure, the Business Process, and the Business Behavior. The Business Model for Network Centric Surface Combatant Land Attack Warfare uses this

structure to view the land attack warfare architecture in terms of goals and problems, resources, processes and events, and system wide behavior.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications, Other (Business)

KEYWORDS: Land Attack, Business Architecture Model, Network Centric Surface Combatant Land Attack Warfare

DEFINING AND VALIDATING A COVERT ANALYSIS DETECTION (CAD) SYSTEM AND ITS STEALTHY DATA CAPTURE, CONTROL AND ANALYSIS CAPABILITIES

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A Covert Analysis Detection (CAD) system is an operationalized honeypot or honeynet that is designed to covertly capture, control and provide analysis capabilities of all traffic that flows through it. It was found that the covert data capture capability not only revealed the attackers tools (captured as source code) and tactics (collection of compromised systems), but also over time it revealed that that attacker's actual motive was the creation of a distributed denial of service (DDoS) network. The discovery of this lethal network tool and all the signatures of its creation and maintenance, proved the validity of the CAD's capabilities to aid in the enhancement of our information protection resources.

DoD KEY TECHNOLOGY AREA: Command, Control and Communications, Computing and Software

KEYWORDS: Network Security, Information Protection, Intrusion Detection, Deception, Deterrence, Honeypot, Honeynet, Distributed denial of service (DDoS)

NAVAL RESERVE SUPPORT TO INFORMATION OPERATIONS WARFIGHTING

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Since the mid-1990s, the Fleet Information Warfare Center (FIWC) has led the Navy's Information Operations (IO) support to the Fleet. Within the FIWC manning structure, there are in total 36 officer and 84 enlisted Naval Reserve billets that are manned to approximately 75 percent and located in Norfolk and San Diego Naval Reserve Centers. These Naval Reserve Force personnel could provide support to FIWC far and above what they are now contributing specifically in the areas of Computer Network Operations, Psychological Operations, Military Deception and Civil Affairs. Historically personnel conducting IO were primarily reservists and civilians in uniform with regular military officers being by far the minority. The Naval Reserve Force has the personnel to provide skilled IO operators but the lack of an effective manning document and training plans is hindering their opportunity to enhance FIWC's capabilities in full spectrum IO. This research investigates the skill requirements of personnel in IO to verify that the Naval Reserve Force has the talent base for IO support and the feasibility of their expanded use in IO.

DoD KEY TECHNOLOGY AREA: Manpower, Personnel, and Training

KEYWORDS: Information Operations, Naval Reserve Personnel

DEVELOPING AND IMPLEMENTING AN ARMY-SPECIFIC INFORMATION TECHNOLOGY WEB-BASED NETWORK MANAGEMENT CONFIGURATION FOR THE INDONESIAN EASTERN FLEET WIDE AREA NETWORK

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This thesis presents a model of an integrated wide area network using web-based network management to support fleet operations of the Indonesian Eastern Fleet. It surveys possibilities for improving the Indonesian Eastern Fleet's computer communications network systems to provide a fast, reliable, and effective way of gathering and distributing information to all fleet units. A standardized LAN infrastructure and the use of an appropriate network hardware and software was recommended to achieve connectivity of all main naval base LANs in an integrated WAN. This thesis provides a design of the Indonesian Eastern Fleet WAN that was tested using a leading edge simulation tool, EXTENDv4.

DoD KEY TECHNOLOGY AREA: Command, Control, and Communications

KEYWORDS: EXTENDv4 Software Simulation Program, Local Area Network, Wide Area Network, Web-Based Technology, Web-Based Network Management

DYNAMIC ASSEMBLY FOR SYSTEM ADAPTABILITY, DEPENDABILITY AND ASSURANCE (DASADA) PROJECT ANALYSIS

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This thesis focuses on an analysis of the dynamic behavior of software designed for future Department of Defense systems. The DoD is aware that as software becomes more complex, it will become extremely critical to have the ability for components to change themselves by swapping or modifying components, changing interaction protocols, or changing its topology. The Defense Advanced Research Programs Agency formed the Dynamic Assembly for Systems Adaptability, Dependability, and Assurance (DASADA) program in order to task academia and industry to develop dynamic gauges that can determine run-time composition, allow for the continual monitoring of software for adaptation, and ensure that all user defined properties remain stable before and after composition and deployment. Through the study, a review of all the DASADA technologies were identified as well as a thorough analysis of all 19 project demonstrations.

This thesis includes a template built using the object-oriented methodologies of the Unified Modeling Language (UML) that will allow for functional and non-functional decomposition of any DASADA software technology project. In addition, this thesis includes insightful conclusions and recommendations on those DASADA projects that warrant further study and review.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Computing, Software, Software Engineering, Software Demonstration

OPEN SOURCE TOOLS: APPLICATIONS AND IMPLICATIONS

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The Internet provides users with unparalleled access to a wide variety of open source tools. Some of the tools may be used in conjunction with others or by themselves, often with great disruptive effect on a target. The rapid pace of discovered vulnerabilities in computer systems, along with the cooperation of expert programmers, has given users access to tools that lower the "entry costs" for conducting sophisticated attacks. Internet security is dependent upon reacting effectively to continually changing modes of attack, and is therefore almost always a step behind, in an action -reaction process.

The availability of pre-tailored attack codes gives possible enemies an avenue to attack the U.S. anonymously, with only a small investment of resources. However, attackers do still need both tools and the knowledge of how to use them to carry out most attacks. Still, more knowledge of the proper utilization of open source tools is progressively being coded into these open source tools, opening up the ability to conduct attacks to a higher percentage of the Internet population.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Internet, Open Source Tools, Computer Vulnerabilities, Information Operations

DEVELOPING AND IMPLEMENTING AN ARMY-SPECIFIC INFORMATION TECHNOLOGY MANAGEMENT CURRICULUM AT THE NAVAL POSTGRADUATE SCHOOL

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Second Reader: LTC Joseph Andrade, USA, Department of Defense Analysis

As the Department of Defense and the Army move into the 21st Century, the need for quality trained Information Systems Management officers, or Functional Area 53 (FA53) officers, is becoming more and more important to meet the demands of the technologically advanced battlefield. These officers are called upon to manage increasingly complex information systems while maintaining an understanding of the limitations imposed by external factors such as the communications systems on which these information systems reside. To ensure Advanced Civil Schooling (ACS)-educated FA53 officers are receiving an education that enables them to function as a fully qualified FA53 officer, this thesis analyzes a series of related areas. This thesis first addresses the military and civilian ACS institutions from which a FA53 officer may receive an advanced degree in the Information Technology (IT) discipline. This thesis will also address the FA53 task list and directly compare this list with the IT curricula at these institutions. Additionally, this thesis will explore the possible implementation of an Army-specific Information Technology Management curriculum at the Naval Postgraduate School (NPS), the potential increase in Army instructors at the NPS to support such a curriculum, and the necessary procedure for periodic updates to the curriculum.

DoD KEY TECHNOLOGY AREAS: Manpower, Personnel and Training

KEYWORDS: Information Systems Management Officers, Functional Area 53, FA53, Information Technology Curricula

PERCEPTION MANAGEMENT AND COALITION INFORMATION OPERATIONS

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This thesis focuses on the conduct of perception management (PM) within coalitions. Research has alluded to the possibility of predicting human behavior by creating stories that convey a believable reality. Further, does PM have any organizational process relationship with engagement planning? Target selection? Press statement coordination? The thesis focuses on how well coalitions are poised to conduct integrated PM operations. It identifies current PM capabilities by studying two recent coalition operations and determines how to best coordinate integration efforts.

The purpose of this study is to analyze various methods of perception management and determine how they can be incorporated into current U.S. Information Operations. One area of study will be the importance of credibility of our leaders when placed in a position of authority. This study will show that credibility is one of the toughest factors to achieve. A second area of study will be the value of story telling in gaining populace support and validation for intervening in conflicts that require the use of force and soldiers. As Stephen Pease said, "the message must be believable, though not necessarily true." (Stephen Pease 1950)

DoD KEY TECHNOLOGY AREAS: Other (Information Systems and Operations, Perception Management)

KEYWORDS: Perception Management, Coalition Operations, Information Systems and Operations, Information Warfare, Information Operations

KNOWLEDGE PORTAL SUPPORT TO THE NAVAL POSTGRADUATE SCHOOL'S ADVANCED DISTRIBUTED LEARNING PROGRAM FOR THE INFORMATION SYSTEMS AND OPERATIONS CURRICULUM

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The Naval Postgraduate School is in the process of migrating the Information Systems and Operations curriculum to a nonresident mode of delivery. Once the migration is complete, there will be a knowledge base available for use by battle staffs as well as policy and acquisition leaders. A knowledge portal may be the solution to facilitating the use of the knowledge base by both learners and operators. The goal of this research is to show how developing a knowledge portal for use with the Information Systems and Operations curriculum knowledge base could expand the use of tacit and explicit knowledge by the operators. By providing access to this repository of information and knowledge, users can capture the most up-to-date knowledge on issues in the world's political and military environment, have the ability to collaborate with experts in the field, and receive answers to questions that will aide in resolving complex issues.

DoD KEY TECHNOLOGY AREA: Other (Information Technology)

KEYWORDS: Knowledge Management, Re-Engineering, Knowledge Portal, Advanced Distributed Learning, Analysis and Design, Information Technology, Information Systems

A DATABASE OF ADVERSARY DECISION MAKERS

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LT Raymond R. Buettner, Jr., USN, Information Warfare Academic Group

Advances in database and decision technologies provide abundant opportunities for implementing decision support systems for Information Operations specialists. This thesis describes, designs, and partially implements a system that provides information about adversary decision makers and the media they access. The Adversary Decision Maker Systems (ADMS) consists of a relational database and associated user interface of forms and reports, implemented in Microsoft AccessTM. The database design and development process is elaborated in detail, database administration guidelines are documented, and a migration path is presented for incorporating relevant decision support tools to augment the database. A decision support system, the Situational Influence Assessment Module (SIAM), which is based upon influence diagrams and belief networks, is used to demonstrate how the database and decision technologies can be integrated. The ADMS developed in this thesis meets the requirements of USPACOM, yet is general enough to be used for any theater commander's Area of Responsibility (AOR).

DoD KEY TECHNOLOGY AREA: Other (Information Operations)

KEYWORDS: Information Systems, Database Technology, Decision Support Systems

EVALUATION OF SURVEILLANCE RECONNAISSANCE MANAGEMENT TOOL AND UTILITY/FUNCTIONALITY TO FUTURE SURFACE COMBATANTS

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Second Reader: Don McGregor, Department of Computer Science

This abstract is classified.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications

KEYWORDS: Not Available

BANDWIDTH REQUIREMENTS FOR THE ADVANCED AMPHIBIOUS ASSAULT VEHICLE (AAAV) COMMAND VARIANT

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David V. Adamiak, Department of Electrical and Computer Engineering

The goal of this thesis is to identify the bandwidth requirements for the command variant of the Advanced Amphibious Assault Vehicle (AAAV). The work focuses on the network established to support an infantry battalion COC. At the center of this network will be the AAAV(C). All higher and subordinate communications links that connect directly with the AAAV(C) are modeled. The intent is to identify all traffic received and transmitted through the AAAV(C). Current systems are not discussed, as this study is intended to be independent of current system characteristics. The model is based on Internet Protocols (IP), with all communications, including voice and video, routed via IP addresses. This model attempts to provide better fidelity for future requirements analysis. Data on message size and transmission interval are

identified that will allow grouping and analysis of message sets for future systems. Doctrinal messages appropriate for each node (unit) are identified and each message is then assigned a size (bits), and a transmission interval (minutes). Using a maneuver ashore scenario, network traffic flows for a 24-hour period are modeled with the software simulation tool Extend™. The model is then optimized and the minimum bandwidth required to support the scenario is identified.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation, Command, Control and Communications

KEYWORDS: Advanced Amphibious Assault Vehicles, AAAV

TACTICAL SIGNALS INTELLIGENCE IN MARINE FORCES PACIFIC: BUILDING THE NEW FIRST RADIO BATTALION

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The reorganization and relocation of First Radio Battalion by Headquarters Marine Corps (HQMC) and Marine Forces Pacific presents a number of logistical and fiscal challenges to coordinate moving manpower and equipment over thousands of miles. This thesis attempts to document and seek solutions to the operational difficulties that have beset the battalion for over 25 years.

First, the battalion's existing tables of organization and equipment have been modified, given the limitations of current structure and expected future operational requirements. Next, the modified tables have been produced as appendices to the thesis to document the finished results. Finally, costs were estimated for personnel transfer and vehicle shipment using the Crystal Ball Microsoft EXCEL spreadsheet add-in. The resulting analyses yield recommendations for relocating and reorganizing the battalion at Camp Pendleton.

DoD KEY TECHNOLOGY AREA: Other (Systems Analysis)

KEYWORDS: Cost Estimation, Systems Analysis, Relocation, Reorganization, Organizational Theory, Resource Allocation

WORLDWIDE METEOROLOGICAL AND OCEANOGRAPHIC DATA DISTRIBUTION USING THE GLOBAL BROADCAST SERVICE

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Second Reader: Charles M. Racoosin, Naval Space Systems Academic Chair

The Fleet Numerical Meteorology and Oceanography Center (FNMOC) produces large meteorological and oceanographic (METOC) data files in support of regional METOC centers worldwide. These data files can be from 50 megabytes to 1 gigabyte in size and can take up to one hour and twenty-eight minutes to send across a T-1 (1.544 Megabits per second (Mbps)) line due to physical limitations and network delays. However, not all of FNMOC's customers have access to a T-1 line. For example, the Naval European METOC Center (NEMOC) in Rota, Spain is hampered by an inadequate telecommunications infrastructure compared to Continental United States (CONUS) standards. This thesis addresses the operational feasibility of using the Global Broadcast Service (GBS), a global system of satellites providing a high speed broadcast service of video and data, for transferring large METOC data products from FNMOC to METOC regional centers around the world.

DoD KEY TECHNOLOGY AREAS: Battlespace Environments, Command, Control and Communications, Computing and Software

KEYWORDS: Global Broadcast Service, GBS, Satellite Communications, Bandwidth, Meteorology, Oceanography, Fleet Numerical Meteorological and Oceanography Center, FNMOC, Joint C4I, C4I, C3, Joint Command, Control, Communications, Computers, and Intelligence Systems, Data Delivery

THE USE OF INTELLIGENT REAL TIME TECHNOLOGIES TO IMPLEMENT, MONITOR AND FORECAST MEDICAL READINESS

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One of the various essentials of military readiness is the administering and continual execution of medical immunizing agents. Service members and civilian personnel working under contract are required to maintain a satisfactory level of medical readiness pursuant to the environment or platform they are assigned to. However, the guidance that oversees and classifies this "satisfactory" level is numerous in volume, broad in terms of definition, and difficult to interpret in terms of the methodology used to assign a specific rating.

Because of the many interpretations of medical readiness, receiving a designated rating of C2 is considered to be acceptable in wartime interactions. Therefore, annual immunization requirements may be neglected throughout one's tenure while still engaging in a wartime environment with the risk of becoming exposed to influenza infection.

The collection, tracking, and analyzing of medical readiness data is interpreted differently thereby prohibiting the facilitation and compilation of adequate information. Medical systems are developed using many different technologies that omit the ability to interface with one another, are in adaptive to change, and do not provide an interactive gateway to permit service members to become proactive and responsible for their own medical readiness state.

DoD KEY TECHNOLOGY AREA: Computing and Software, Manpower, Personnel, and Training

KEYWORDS: Medical, Readiness, Intelligent, Technologies, Web Application

A WIRELESS LOCAL AREA NETWORK COMMAND AND CONTROL SYSTEM FOR EXPLOSIVE ORDNANCE DISPOSAL INCIDENT RESPONSE

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Navy Explosive Ordnance Disposal (EOD) teams currently use a hardwire intercom system for command and control when responding to EOD incidents. This system is archaic, awkward, and cumbersome. A modern information system will greatly improve safety and efficiency during EOD operations. This thesis presents a lightweight, ruggedized, field portable, wireless local area network (LAN) designed for use by U.S. Navy EOD teams during EOD incident responses. The information system provides a voice, video, and data link between the command post and the down range response team, thus offering significant improvements over current EOD command and control methods. The system components are commercial off the shelf technology (COTS) and are chosen based on specification analysis for performance, reliability, availability and cost. Calculations for traffic flow analysis, electromagnetic radiation (EMR) levels, and theoretical range are provided. Based on the new capabilities provided by the system, revised response

tactics for EOD teams are proposed that allow multiple render safe procedures to be conducted simultaneously by a singe team, thus providing a quantum leap in efficiency.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Wireless LAN, Navy Explosive Ordinance Disposal, COTS, Response Tactics

AN APPLICATION OF ROLE-BASED ACCESS CONTROL IN AN ORGANIZATIONAL SOFTWARE PROCESS KNOWLEDGE BASE

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The Organizational Software Process Knowledge Base (OSPKB) is the repository of an organization's software process, product performance, quality metrics, and corporate lessons learned. The knowledge is maintained on a project-by-project basis, as well as by business domain. The OSPKB contains sensitive data and information that needs to be protected from unauthorized disclosure or modification. In this thesis, we address the challenge of controlling access to the data and information stored in the OSPKB. In particular, we investigate approaches to applying role-based access control (RBAC) to OSPKB applications.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Project Management, Software Process Management, Role-Based Access Control, Security

MODELING JAMMING EFFECTS ON ROLLING AIRFRAME MISSILE

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Development of countermeasures against infrared and optical guided missiles is enhanced by an ability to quantify the effects of the countermeasure. Analysts must be capable of accurately determining the attitude of the missile throughout its flight. This thesis describes the use of microelectronic-miniature (MEM) technologies to measure the strap down rates experienced by a rolling airframe missile and the model required to effectively determine the missile's attitude during its flight. The Tokin America CG-16D rate sensors and the Honeywell, SSEC, HMC 1002 roll sensor were used in an inertial measurement unit (IMU). The size of the IMU is small and rugged enough to be installed in a small diameter missile. A SIMULINK model is presented that performs the tasks of demodulating the sensors, performing coordinate transformation, and providing animation of the missile attitude for analysis. The model was evaluated for its ability to accurately determine the attitude of the missile based on input from the IMU packages. Sensor data was obtained from testing performed on a CARCO table flight motion simulator, and compared to the ground truth data provided by the CARCO table. Previous research had proved that this model worked for slow-spinning missile (5 Hz in roll). This thesis research expands that research to a fast spinning missile (15 Hz in roll). Through testing, the model was capable of providing solutions within the 2 degrees RMS requirement.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation, Sensors

KEYWORDS: Countermeasures, Infrared and Optical Guided Missiles, Microelectronic-Miniature, MEM, Missile Altitude

AIRBORNE EXPLOITATION OF AN IEEE 802.11B WIRELESS LOCAL AREA NETWORK

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Deployment of IEEE 802.11b wireless local area networks is increasing around the globe due to their cost compared to wired infrastructures, availability, versatility and recent performance gains in the areas of transmission speed. Coupled with its ease of implementation, IEEE 802.11b wireless local area networks provide a viable solution for convenient information access. Unfortunately, wireless LANs remain a new technology not fully understood by the organizations implementing them. IEEE 802.11b wireless local area networks are vulnerable to intrusion and exploitation due to its broadcast infrastructure. Adding a wireless network to an organization's internal LAN may open a potential backdoor into the existing wired network. This research investigates the feasibility of exploiting an IEEE 802.11b WLAN from an airborne platform for the purpose of gaining access into the backbone wired network. It explores the viability of exploiting the 802.11 standard through the Medium Access Control (MAC) Layer, looking at link analysis and the use of high-gain antennas and commercial-off-the-shelf (COTS) software to intercept and process these radio frequency signals. The research concludes with an evaluation of optimum flight profiles for intercepting and collecting IEEE 802.11b signals based on the performance in actual test flights.

DoD KEY TECHNOLOGY AREAS: Computing and Software

KEYWORDS: Wireless LAN, IEEE 802.11b Standard, Minimum Access Control, MAC, COTS, Optimum Flight Profiles

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